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THE FAMINE IN INDIA.

INDIA is once more undergoing a severe trial. Scarcely had the effects of the famine of 1897 disappeared when the food supply again gave out, with the result that the people are now face to face with a famine of water, food and cattle, which, in the particular areas affected, is unprecedented in character and intensity. At this period of the previous famine, only 1,000,000 people were receiving government relief in entire India. To-day the official estimate places the number at 3,500,000, and the daily expenditures at about $84,000.

The true famine area in British India and the native states is about 300,000 square miles, with a population of 40,000,000. There is a further area of about 145,000 square miles, with a population of 21,000,000, in which the immensity of its territory. As regards the climate, that is generally dry, owing to the shortness of the season of rains. When, during such season, but little water falls, and the fall is slightly less than the average, the harvest is doomed. It is in vain to sow, since the cereals will yield but an inadequate crop; and, since even the normal crop is not over sufficient, it does not permit of making provision for more than a few months. As soon as it diminishes, we may rest assured that a famine will ensue. So the catastrophe is plainly foreseen several months in advance. What there is to be depended upon is known as far back as August or September, the season of rains. When the rains do not appear at this time they will not do so later on; and the future situation is, therefore, a foregone conclusion.

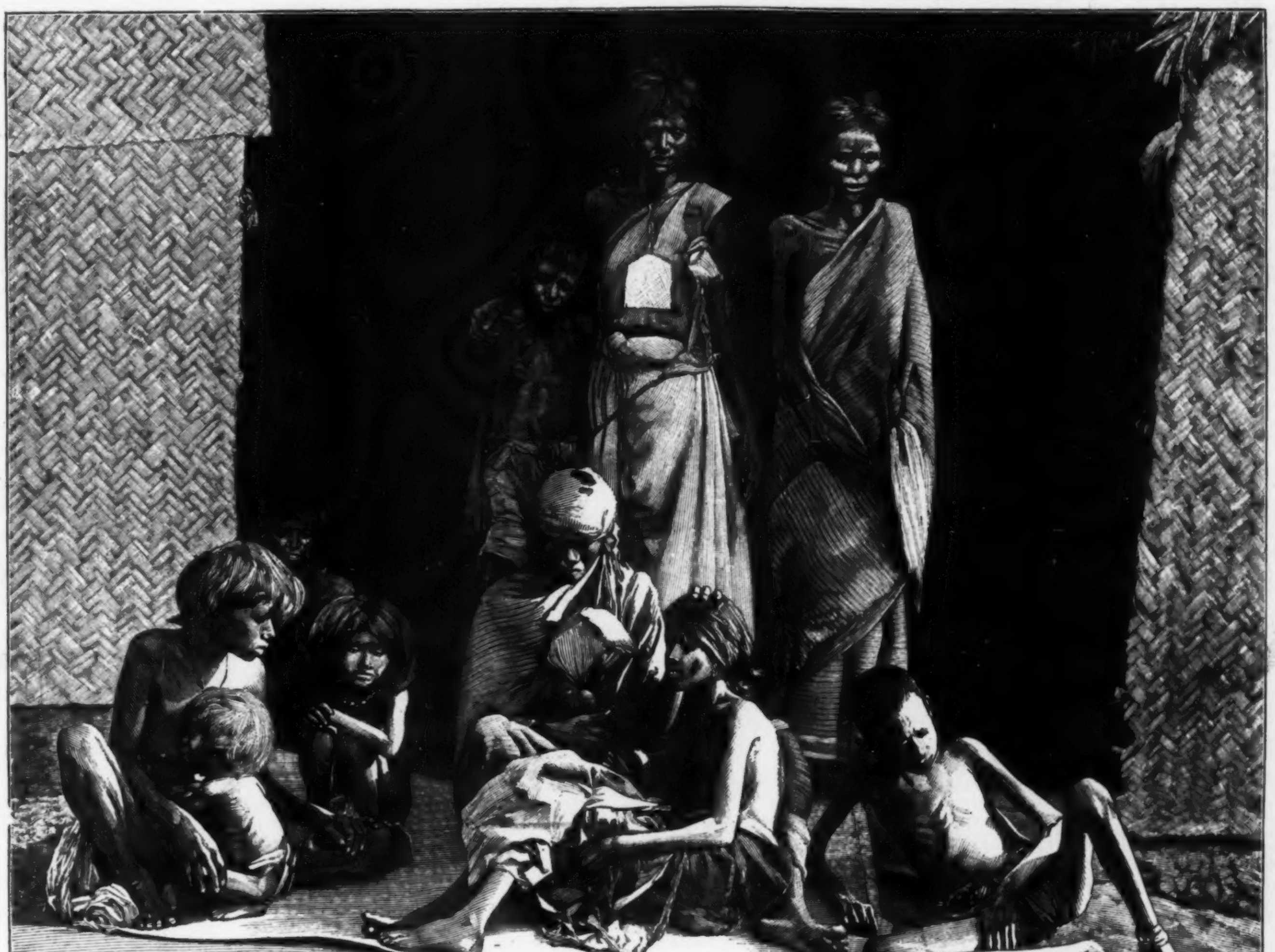
As for the people, they possess neither implements nor methods, and their agriculture is of an extremely rudimentary character. It permits the natives to exist in ordinary times, but not to put anything by. There is neither food nor water placed in reserve, and the people live, in a manner, from hand to mouth. With a proper amount of foresight and science the agricultural population might greatly improve its condition; but such qualities neither come to nor are taught to a people all at once.

As regards the immensity of the territory, it may be said that there are vast spaces that railways do not reach and to which it is almost impossible to send the food furnished by public charity or the government. In remote villages the inhabitants die before being able to receive supplies, or else scatter through the forest, which, being dry, affords no nourishment in the way of fruits. This is why, despite science, which permits of foreseeing the event, and, despite the good will of the government, which does all that it can in the way of giving remunerative employment that shall permit of purchasing the food necessary, the catastrophe supervenes. At present there are, as already stated, at least three and a half million natives who are living only through assistance. Many of these are dying, too, since the rations are short, and it requires but a slight diminution in the daily bill of fare to lead the unfortunates, who for years have not fully satisfied their hunger, to the gates of death.

As may be seen, the starving people of India are wretched beings, who have been suffering for a long time and who have gradually grown gaunt and become thoroughly worn out. Photography alone is capable of giving an adequate idea of their condition, since it speaks with more eloquence than words.

In the accompanying photographic reproductions borrowed from l'Illustration, it will be remarked that these starving persons often have a distended abdomen. It must not be concluded from this, however, that the unfortunates have just had a good meal, since such distinction is due, in fact, to indigestible substances, gases and a hypertrophied liver. They are likewise nearer to death than the others, and their end is a question of but a few weeks, if not of but a few days.

It is painful to think that it is possible for deaths to occur through such causes at an epoch like ours.



GROUP OF STARVING PEOPLE IN INDIA.

more or less scarcity and distress prevail, where relief is already being given in a tentative form, or will probably have to be given before the advent of the next monsoon.

The most trying period of the famine is still two months ahead, and even now it is questionable whether the financial resources of the government and the power to provide useful employment for so vast a number of people will prove equal to the strain, if present standards are to be maintained.

The thoughts of almost every Englishman throughout the empire are now fixed upon the war in South Africa. It would be too much to expect that England can again come to the rescue as splendidly as she did in 1897, and it seems clear that India must fight the plague and famine with her own means.

It may seem astonishing that a country ruled by a civilized race should know the horrors of famine; and yet nothing is easier to explain. The famine in India is due to its climate, the vastness of its population and

As a Powder for Silvering Copper Kettles for Fruit Juices, Etc.—The following composition is said to have been found valuable: Potassium cyanide, 12·0; silver nitrate, 6·0; lime spar, 30·0. Finely powdered, it is used for rubbing the copper with it, until it is lustrous white. Any adhering potassium cyanide may be quickly removed by rinsing with water.—Pharmaceutische Centralhalle.

[Continued from SUPPLEMENT, No. 1268, page 20325.]

CRUISE OF THE "ALBATROSS."—IV.

MR. AGASSIZ's final letter to the United States Fish Commission on the voyage of the "Albatross" is dated Yokohama, Japan, March 5, 1900.

After coaling and refitting we left Suva on December 19, and arrived at Funafuti on the 23d, stopping on the way at Nurakita, the southernmost of the Ellice Islands. I was, of course, greatly interested in my visit of Funafuti, where a boring had been made under the direction of a committee of the Royal Society, in charge of Professor David, of Sidney, after the first attempt under Professor Sollas had failed. The second boring reached a depth of more than 1,100 feet. This is not the place to discuss the bearing of the work done at Funafuti, as beyond the fact of the depth reached we have as yet no final statement by the committee of the interpretation put upon the detailed examination of the core obtained, and now in the hands of Professor Judd and his assistants. In addition to the above named islands, we also examined Nukufetau, another of the Ellice group.

After leaving Nukufetau we encountered nothing but bad weather, which put a stop to all our work until we arrived under the lee of Arorai, the southernmost of the Gilbert Islands. On our way to Tapateuea from there we steamed to Apamama and Maiana, which we examined, as well as Tarawa. We next examined Maraki, an atoll which is nearly closed with high beaches, having only two small boat passages leading through the narrow outer land-rims. Both Maraki and Taritari, the last island of the Gilberts which we examined, are remarkable for the development of an inner row of islands and sandbars in certain parts of the lagoon parallel to the outer land-rim, a feature which also exists in many of the Marshall Islands atolls.

We reached Jaluit January 9, and after a few few days spent in coaling, we spent about three weeks in exploring the Marshall Islands, taking in turn the atolls of the Ralick Chain to the north of Jaluit; Ailinglab Lab, Namu, Kwajalong, and Rongelab; and then the atolls of the Ratack Chain, Likieb, Wotje, and Arhno. The atolls of the Marshall group are noted for their great size and the comparatively small area of the outer land-rims, the land-rims of some of the atolls being reduced to a few insignificant islands and islets. In none of the atolls of the Ellice, Gilbert or Marshall Islands were we were able to observe the character of the underlying base which forms the foundations of the land areas of these groups. In this respect these groups are of striking contrast to the Paumotus, the Society Islands, the Cook Group, Niue, the Tongas, and the Fiji Islands, where the character of the underlying foundations of the land-rims is readily ascertained. But, on the other hand, these groups give us the means of studying the mode of formation of the land-rims in a most satisfactory manner, and nowhere have we been able to study as clearly the results of the various agencies at work in shaping the endless variations produced in the islands and islets of the different atolls by the incessant handling and rehandling of the material in place, or of the fresh material added from the disintegration of the sea or lagoon faces of the outer land, or of the corals on the outer and inner slopes. It has been very interesting to trace the ever-varying conditions which have resulted in producing so many variations in the appearance and structure of the islands and islets of the land-rims of the different groups.

The boring at Funafuti will show us the character and age of the rocks underlying the mass of recent material of which the land-rim, not only of that atoll, but probably also that of the other atolls of the group and of neighboring groups, is composed, though, of course, we can only judge by analogy of the probability of the character of the underlying base from that of the nearest islands of which it has been ascertained. When we come to a group like the Marshalls we have as our guide only the character of the base rock of the islands of the Carolines, which is volcanic, while Nauru and Ocean Islands, to the west of the Gilberts and to the southwest of the Marshalls, indicate a base of ancient tertiary limestone.

Owing to the continued stormy weather and the probability of not being able to land at these islands while the unfavorable conditions lasted, we did not attempt to visit them.

After leaving Suva we made a number of soundings from south of Nurakita toward the Marshall group, which, in addition to those of the "Penguin," clearly show that the Ellice Islands are isolated peaks rising from considerable depths (from 1,500 to over 2,000 fathoms), and that the same is the case with the Gilbert Islands. We made about thirty soundings between the atolls of the Marshalls, which appear to show that they also rise as independent peaks or ridges, with steep slopes, from 2,000 to 2,500 fathoms, and that the so-called parallel chains of atolls of the Marshalls, the Ralick and Ratack, are really only the summits of isolated peaks rising but a few feet above the sea-level. The Marshall Islands, as well as the Ellice and Gilbert, seem to be somewhat higher than the Paumotus, but this difference is only apparent and is due to the difference in the height of the tides, which is very small in the Paumotus, while in these groups it may be five and even six feet.

From Jaluit we visited among the Carolines, the islands and atolls of Kusaie, Pingelap, Ponapi, Andema, Losap, Namu, the Royalist Group, Truk and Namonuito, obtaining thus an excellent idea of the character of the high volcanic islands of the group from our examinations of Kusaie and of Ponapi, while the others represent the conditions of the low atolls, having probably a volcanic basis, but this was not observed at any of those we examined.

The reefs of the volcanic islands of the Carolines are similar in character to those of the Society Islands, though there are some features, such as the great width of the platforms of submarine erosion of Ponapi and of Kusaie, and the development of a border of mangrove islands at the base of the volcanic islands, which are not found in the Society Islands.

The Truk Archipelago was, perhaps, the most interesting of the island groups of the Carolines, and it is the only group of volcanic islands surrounded by an encircling reef which I have thus far seen in the Pacific which, at first glance, lends any support to the theory of the formation of such island-groups as Truk by subsidence. This group was not visited by either Darwin or Dana; and I can well imagine that an investigator, seeing this group among the first coral reefs, would readily describe the islands as the summits, nearly denuded, of a great island which had gradually sunk. But a closer examination will readily show, I think, that this group is not an exception to the general rule thus far obtaining in all the island groups of the Pacific I have visited during this trip; that we must look to submarine erosion and to a multitude of local mechanical causes for our explanation of the formation of the atolls and of barrier and encircling reefs, and that, on the contrary, subsidence has played no part in bringing about existing conditions of the atolls of the South and Central Pacific.

Nowhere have we seen better exemplified than at Truk how important a part is played by the existence of a submarine platform in the growth of coral reefs. The encircling reef protects the many islands of the group against a too rapid erosion, so that they are edged by narrow fringing reefs, and nowhere do we find the wide platforms so essential to the formation of barrier reefs. The effect of the northeast trades blowing so constantly in one direction for the greater part of the year is, of course, very great; the disintegration and erosion of islands within its influence is incessant, and their action undoubtedly one of the essential factors in shaping the atolls of the different groups, not only according to the local positions of the individual islands, but also according to the geographical position of the groups. Thus far I do not think any observer has given sufficient weight to the importance of the trades in modifying the islands within the limits of the trades, nor has anyone noticed that the coral reefs are all situated practically within the limits of the trades both north and south of the equator.

The soundings made going west from Jaluit to Namonuito indicate that there is no great plateau from which the Carolines rise, but that the various groups are, as is the case with the neighboring groups of the Marshalls and Gilberts, isolated peaks with steep slopes rising from a depth of over 2,000 fathoms. The line we ran from the northern end of Namonuito to Guam developed the eastern extension of a deep trough running south of the Ladrones. The existence of this trough had been indicated by a sounding of 4,475 fathoms to the southwest of Guam made by the "Challenger." We obtained, about 100 miles southeast of Guam, a depth of 4,813 fathoms, a depth surpassed only, if I am not in error, by three soundings made by the "Penguin" in the deep trough extending from Tonga to the Kermadecs.

I was very much surprised, in approaching Guam

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from the eastward, to find that the island was not wholly volcanic, but that the northern half has been built up of elevated coralliferous limestone. The vertical cliffs bordering the eastern face rise from a height of 100 to 250 or 300 feet at the northern extremity, and resemble in a way similar islands in the Paumotus (Makatea), Niue, Eua, Vavau, and others in the Fijis which had made their cliffs a familiar feature in our explorations. In fact, outside of Viti Levu and Vanua Levu, this is the largest island known to me where we find a combination of volcanic rocks and of elevated coralliferous limestone. The massif forming the southern half of the island is volcanic, and the highest ridge, rising to about 1,000 feet, runs parallel to the west coast, the longest slope being toward the east.

This volcanic mass has burst through the limestone near Agaña, and the outer western extension of the coralliferous limestone exists only in the shape of a few spurs running out from the volcanic mass, the largest of which are those forming the port of San Luis d'Apra. These spurs are separated by lower ridges of volcanic rocks extending to the sea from the main central mass. To the north of Agaña the limestone forms an immense irregular mesa, cut by deep crevasses, full of pot-holes and sinks, rising gradually westward to a height of 350 or 400 feet. Near the northern extremity of the island a volcanic mass, Mount Santa Rosa, has burst through the limestone and rises about 150 feet above the general level of that part of the island. The shore stratification of the bluffs is much distorted in the vicinity of that volcanic outburst.

We left Guam in time to reach Rota by day, and found that this island is a mass of elevated coralliferous limestone, the highest cliffs of which reach a height of 800 feet. Perhaps in none of the elevated islands have we been able to observe the terraces of submarine elevation as well as at Rota, especially in the small knob at the southwest point of the peninsula separating Sosanlagh and Sosanjaya Bays, which itself is also terraced; no less than seven distinct terraces could be traced. There was no sign of any volcanic outburst except at the northwest point of the island, where both the character of the slope and of the vegetation would seem to indicate volcanic structure.

It is quite probable that others of the Ladrones, like Saipan, and the islands to the south, are composed in part at least of elevated limestone judging from the hydrographic charts and the sketches which accompany them. On many of the Northern Ladrones there are active volcanoes, so that it is very possible that the volcanic outbursts which have pushed through the limestone, or have elevated parts of the islands of the group, are of comparatively recent date.

During the last part of our cruise, from Suva to Guam, the unfavorable weather greatly interfered with our deep-sea and pelagic work; in fact, with the exception of the soundings made to develop as far as practicable the depths in the regions of the various coral-reef groups we visited, we abandoned all idea of carrying out the deep-sea and pelagic work planned for the district between the Gilbert and Marshall and Caroline groups. To our great disappointment hardly any marine work could be accomplished, and our investigations were limited almost entirely to the study of the coral reefs of the regions passed through.

After Mr. Townsend's departure, Dr. Moore continued to collect the birds of the islands where we anchored, and they have brought together a fairly typical collection of the avifauna of the South Sea Islands. Dr. Pryor collected the characteristic plants, and Dr. Mayer the insects and reptiles in addition to such pelagic work as could be done in port. Both Dr. Woodworth and Dr. Mayer took a large number of photographs, and we must have at least 900 views illustrating the coral reefs of the Pacific. Dr. Woodworth also collected incidently such ethnological material as could readily be obtained during our short stay at different places.

We were everywhere received with the greatest cordiality and courtesy: by the Governor of the Paumotus, the King of Tonga, Sir George O'Brien (the High Commissioner of the Western Pacific at Suva), Mr. E. Brandeis (the Landes-Hauptman in charge of the Marshall Islands at Jaluit), and the Governor of the Carolines. The State Department at Washington having kindly asked through the French, English, and German Embassies at Washington for the kind offices of the representatives of these nations in Oceania to the "Albatross" while in their respective precincts, thanks to these credentials nothing could exceed the interest shown everywhere in the success of our expedition.

I must also thank Capt. Moser and the officers of the "Albatross" for the untiring interest shown by them during the whole time of our expedition in the work of the ship, which was so foreign to the usual duties of a naval officer. A. AGASSIZ.

AN ASSUMED INCONSTANCY IN THE LEVEL OF LAKE NICARAGUA; A QUESTION OF PERMANENCY OF THE NICARAGUA CANAL.

By C. WILLARD HAYES, United States Geological Survey.

A PAPER under the above heading by Prof. Angelo Heilprin appears in the SCIENTIFIC AMERICAN of February 24, 1900. To one not familiar with the investigations which have been carried on in this portion of the isthmian region, the conclusions reached by Prof. Heilprin appear to have some foundation; and, since they cast a doubt upon the feasibility of the proposed Nicaragua Canal and on its permanence after construction, the questions raised are of sufficient importance to be answered somewhat fully.

Stated very briefly, Prof. Heilprin's premises and conclusion are as follows: In 1781, the Spanish engineer, Galisteo, determined the altitude of Lake Nicaragua to be 133·11 feet above low water in the Pacific. Later, in 1838, Lieut. Baily ran a line of levels from the Pacific and made the altitude of the lake surface 128·3 feet above low water at San Juan del Sur on the Pacific. In 1852, Col. Childs surveyed a route for an isthmian canal and determined the elevation of the lake to be about 108 feet above mean sea-level. Subsequent determinations by Lull in 1873, Menocal in 1885, the Maritime Canal Company in 1890, and the Nicaragua Canal Commission in 1898, have reached substantial agreement as to the elevation of the lake, making its mean about 104 feet above mean tide in the Pacific. This discrepancy of 20 to 25 feet between the earlier and later determinations of the lake level has generally been ascribed to the inaccuracy of the earlier surveys. Prof. Heilprin, however, concludes that the earlier determinations were correct, and that the level of the lake has subsided that amount between the dates of the earlier and the later surveys. It will readily be seen that a region subject to a change in elevation of 20 feet in a period of 14 years (between 1838 and 1852) would offer serious obstacles to the construction of a canal of the magnitude of the one proposed, or to its permanency after construction.

Three causes, singly or in combination, might bring about a change in altitude of the lake surface: (1) A depression of the whole of this portion of the isthmus without warping; (2) a depression of the lake basin by warping, the sea margins remaining constant; (3) a cutting down of the lake outlet.

1. If the whole isthmian region had undergone recent subsidence, the evidence of such a change would be manifest at the coast. Greytown is located upon a low sandy beach, which was thrown up by the surf, and has within the past century been cut off from the sea by a sand spit which inclosed first a harbor and then a closed lagoon. This land has not been added to since it was exposed to the surf early in the century, and any change in elevation, even of a few feet, would be quickly apparent and would be a matter of record. The surface of the San Juan deltaplain ascends from the margin of the sea with a regular gradient merging at its inner margin with the floodplain, as determined by the volume and load of the river. This regular gradient precludes the possibility of any recent change in altitude of this region. Even a slight subsidence would permanently flood extensive areas, and a corresponding rise would cause the streams to deepen their channels so that the flood waters would no longer overtop the banks.

The same evidence of stability is in general true of the Pacific coast. The streams flowing to the Pacific from the divide opposite the southern end of the lake occupy, in their lower courses, drowned channels which have been more or less completely silted up. Any recent depression of the coast would have flooded these alluvial valleys and produced irregularities in their gradient. No such flooding is observed, but, on the contrary, unmistakable evidence that present conditions have prevailed for a considerable time, certainly for several centuries. In the vicinity of Corinto, on the Pacific coast, northwest of the depression which holds Lakes Nicaragua and Managua, there has been a recent subsidence of a few inches, and this is well recognized by the people of the region, and its amount has been determined by the engineers of the railroad which runs from Corinto to Momotombo. This shows that rapid changes of level, even of small amount, are quickly recognized, and that a depression of 20 feet of any occupied portion of the coast could not possibly escape notice.

2. Lake Nicaragua is about 100 miles long and 45 broad. It formerly extended eastward at least 25 miles farther to the present position of Castillo Rapids. Now, it has been shown above that the coast on either side of the isthmus, at least opposite the southern end of the lake, has not suffered recent subsidence. A depression of the lake basin itself sufficient to produce a decrease in the altitude of its surface amounting to 20 feet would almost certainly have produced more or less tilting of the surface by the subsidence of some portions of the lake's perimeter more than others. It is quite inconceivable that the region should have been warped in such a manner, that the lake shore at Las Lajas should be lowered 20 feet, while the Pacific coast, only 12 miles distant, was not affected, and that at the same time every part of the lake shore should also be depressed an exactly equal amount. But if the basin had been unequally depressed, some portions of the shore would be drowned, while at other points the lake bottom would be laid bare, and raised beaches left at the former shore line. Nearly the entire circuit of the lake was made by the writer, and its shores were carefully studied with the object of determining whether or not there existed any evidence of recent changes in level. Owing to the regularity of the winds which prevail in this region, the different portions of the lake shore present wide differences in character, but there is everywhere a nice adjustment of shore features to present conditions. At the lower end and along the northeastern side, where there is generally an offshore wind and consequently no surf, the streams have built extensive deltas out into the lake, and the surface of the deltaplains and floodplains is regulated by the fluctuations in height of streams and lake due to seasonal changes. A depression of 6 feet relatively to lake level would permanently flood these deltaplains, while an elevation of equal amount would raise them above flood level and start the streams to deepening their channels and building new deltas at lower levels.

Along the southwestern side of the lake there is a rather heavy surf throughout the greater part of the year. Wave erosion is, therefore, progressing more or less rapidly, according to the character of the rocks. The width of the beach between the water margin and the base of the wave-cut cliff is everywhere perfectly adjusted to the seasonal fluctuations in level and the character of the materials in which the cliff is cut. Any recent change in the relation of lake level to shore would necessitate a readjustment of these conditions. An elevation relatively to lake level would have raised beaches above the reach of the highest flood water. A depression would drown the beach and start the waves to cutting at a higher level. Nothing of this kind was found, and it is certain that the relations of lake level to land have not suffered recent change on this side of the lake. The changes at the upper end of the lake, in the vicinity of Tipitapa River, cited by Prof. Heilprin, will be discussed later.

3. A third way in which the level of the lake might have been lowered is by the cutting down of its outlet. As fully explained in the report of the Canal Commission, 1897–98, it appears probable that the level of the lake was early in its history determined by a rock sill over which the Rio San Juan flowed at Castillo. This sill has since been cut down somewhat, and the lake level is now held by the delta of the Rio Sabalos which forms the Toro Rapids. From the point where it issues from the lake to the Toro Rapids, the Rio San Juan meanders through an alluvial plain, which represents a former extension of the lake silted up by tributary streams except for the channel kept open by the outflow from the lake. The surface of this plain stands at such a level that it is just covered by the streams when in flood. In other words, it has the character of a growing floodplain and proves conclusively that present relations have held for a considerable time. Any lowering of the lake level by cutting down the outlet would at once leave this alluvial plain above the reach of floods and completely change its character. As has already been pointed out, the sill which holds the lake at its present level is a delta deposit, and it will not long resist corrasion of the waters which cross it; so that in a relatively short time, as geological changes go, the river may be expected to begin the rapid trenching of its upper channel and eventually, unless artificially checked, lower the lake level.

The evidence that the lake level has not been lowered by this third method is, of course, confirmed by the absence of raised beaches about the lake, where they would certainly be a conspicuous feature if the change had taken place as suggested.

Changes in the conditions of the upper end of Lake Nicaragua have been cited by Prof. Heilprin as evidence of recent lowering of the lake's level. This doubtless arises from ignorance of the peculiar physical conditions which prevail there. As stated before, the constant trade winds which sweep across the lake produce a heavy surf along its southwestern margin throughout the greater part of the year. The oblique direction at which the waves strikes the shore sets up a strong littoral current, by which the sand is transported toward the northwest and deposited at the end of the lake. A sand spit 10 miles in length has been built across the point of the lake, cutting off a broad, shallow lagoon and crowding the Tipitapa River to the extreme margin of the valley. From the rate at which the shore in the vicinity of Granada is being cut away and at which the materials are being transported northward, it is easy to understand how rapid changes might take place in the character of the Tipitapa River and convert it in a few years from a deep estuary to a shallow lagoon. The amount of water passing through the Tipitapa River is entirely independent of the elevation of Lake Nicaragua, since it depends wholly upon the relation between rainfall and evaporation in the basin of Lake Managua. Changed conditions at the head of the lake, therefore, do not in any way support the contention that the level of the lake has fallen in recent times.

It might be inferred from Prof. Heilprin's article that Lake Nicaragua is in the heart of a volcanic region subjected to frequent destructive earthquakes. This subject of volcanism and the probability of earthquakes of sufficient intensity to injure canal structures is fully discussed in the recent report of the Canal Commission. It need only be stated here that the canal region lies midway between the Costa Rican volcanoes to the south and the Nicaraguan volcanoes to the north, and that the volcanic activity in both these groups is evidently on the wane. No earthquake of destructive violence has visited the canal region since its occupancy by the Spaniards, and the two centers of the moderate seismic activity, namely, Irazu on the south and the Maribios Range on the north, are respectively 60 and 100 miles from the nearest portions of the canal route.

The quotation from the English engineer, Colquhoun, indicates that the latter was a superficial observer whose conclusions were drawn from a relatively short period of observation. It is quite true that the amount of water flowing in the lower San Juan is becoming smaller each year, but this is due to a corresponding increase in the Rio Colorado, which is now the main distributary from the head of the delta to the sea. This successive transfer of the main channel to more southerly distributaries has been fully discussed in the report above cited. Even between the head of the delta and the mouth of the San Carlos, one is impressed in the dry season with the insignificant volume of the Rio San Juan, and if one's observations were confined to this period, he might readily believe that a permanent diminution in the volume of the stream had taken place. This, however, is merely a seasonal fluctuation.

Prof. Heilprin's citation of the fluctuation in altitude of various lakes, as Great Salt Lake and Lake Tanganyika, has no bearing whatever upon the question, since these are inclosed lakes and the observed great fluctuation of their levels is directly connected with cycles of climatic change. The fluctuations in level of Lake Nicaragua due to seasonal changes have been fully discussed by Chief Engineer Wheeler and Hydrographer Davis in the report of the Canal Commission. This fluctuation possibly reaches an extreme range of 14 feet, although the ordinary range is undoubtedly less than 10 feet. With the rise in its surface due to extraordinary precipitation, the section of the outlet increases so rapidly that the balance is soon reached between inflow and outflow, and it is, therefore, impossible for the level of the lake to reach the elevation given by Lieut. Baily merely by reason of heavy precipitation. It appears, therefore, in view of the consistent physiographic evidence, that, notwithstanding these earlier determinations the level of Lake Nicaragua has remained constant except for slight seasonal fluctuations, at least for a period whose length has to be measured in centuries; and, furthermore, it appears that the geologic conditions in this portion of the isthmus are such that they afford a promise of future stability, and that the region is, therefore, favorable for the construction and maintenance of a work such as the proposed Nicaragua Canal.—The National Geographic Magazine.

PRODUCTION OF ALKALINE CYANIDES.

THIS process applies to the production of alkaline cyanides by the calcination of potassium and sodium prussiates, and has for its object the avoidance of the greater part of the loss of cyanogen previously experienced.

In a vessel heated to the necessary temperature, the dried prussiate is placed with caustic soda (or potash) rendered as anhydrous as possible. To this mixture is added, in the state of minutely divided

powder, the calcium carbide of commerce. All these bodies are mixed in atomic proportions.

The calcium carbide acts on the only oxygenated body in the mixture; that is, on the soda or potash, and sets the metal at liberty.

The sodium or potassium thus set free is in a molecular state in presence of the cyanogen which was united with the iron, and which is also set free by the calcination. The union of these two substances gives rise to the sodium cyanide by virtue of the law that it is the most stable body which tends to produce itself.

An energetic agitation of the fused mass causes an intimate mingling of all the substances favoring the meeting of different molecules. It remains only to filter by means of the warm filter used in this industry, which separates the residue composed of iron and lime.—La Revue des Products Chimiques.

MODERN FIELD ARTILLERY.

THE MOUNTAIN GUN.—This 75-millimeter gun is specially suitable for mountain use. The mountain carriage, may be drawn short distances, over smooth roads, for which purpose a pair of shafts are provided to fit into the sockets of the trail end. The front ends of the shafts are supported by lugs and straps attached to the ordinary pack-saddle, as shown; but for long marches and in mountainous countries, the different parts of the equipment are carried on mules, making in all four loads. The pack-saddles are all interchangeable, i. e., any load can be carried by any animal provided with a saddle. The loads are thus made up on the five mules:

1. Gun with mechanism.

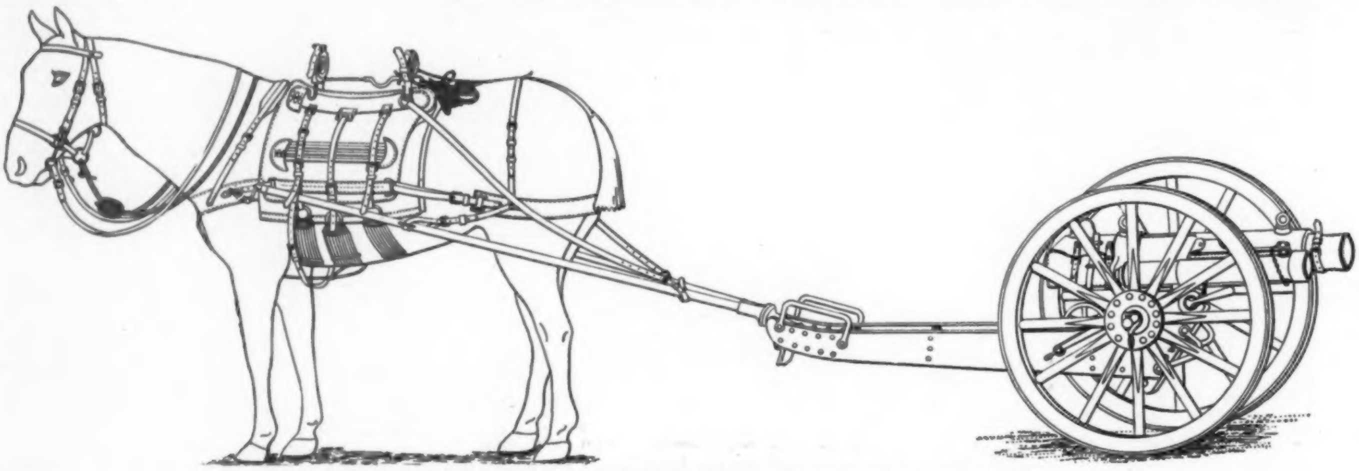


FIG. 1.—VICKERS, SONS & MAXIM'S MOUNTAIN GUN AND CARRIAGE.

2. Cradle, which is cast in one piece with the recoil buffers.

3. Trail, complete with elevating gear.

4. Axle, wheels, and tool-boxes.

5 and following loads hold each twelve rounds of ammunition carried in four boxes.

With each of the three first-mentioned loads there are two hand-spikes or carrying bars to facilitate the lifting of the loads onto the mules.

DISMOUNTING THE MOUNTAIN GUN FOR MULE SADDLING.—The operation of dismounting the gun preparatory to loading the mules may be described:

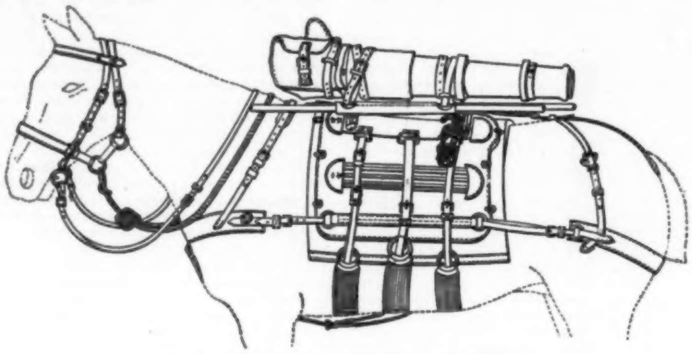


FIG. 2.—GUN MOUNTED ON MULE.

1. Take the rear sight out of its socket, and place it in the case provided on one side of the cradle. Release the catches on the piston-rods; turn the two piston-rod handles upward as far as they will go. The gun is now free, and can be withdrawn by putting a rod through the eyelet, and in this way can be carried onto the mule.

2. Put the cradle in greater depression by turning the handwheel till the arrows marked on the handwheel bolt and the elevating worm-bolt meet, after releasing the catch, turn the axis bolt handle as far as it will go to the rear—that is, a quarter of a turn. The cradle is now free to be lifted off the trail and placed on the mule.

3. To detach axle and wheels, support the front end of the trail by handles, then turn the axle lever 90 degrees upward after releasing its latch. Roll axle and wheels back, and put hand-spikes through the loop handles and place the trail on the mule.

4. The fourth load is made up of axle and wheels, drag-washers and linch-pins to be replaced on the axle after the wheels have been taken off.

MULE LOADS.—And now we may give the loads on each of the mules as illustrated.

In the gun load (Fig. 2) the gun is carried on the top of the saddles, and on each side there is a lifting-rod

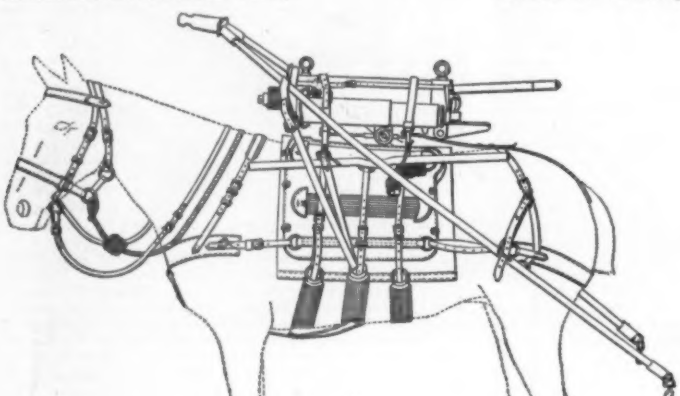


FIG. 3.—THE CRADLE LOAD.

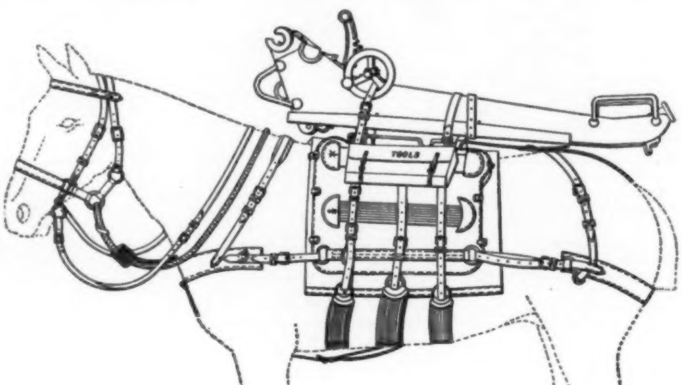


FIG. 4.—THE TRAIL LOAD.

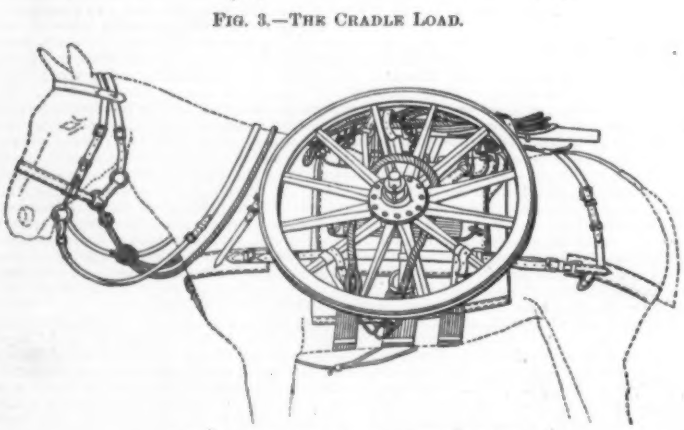


FIG. 5.—THE AXLE AND WHEEL LOADS.

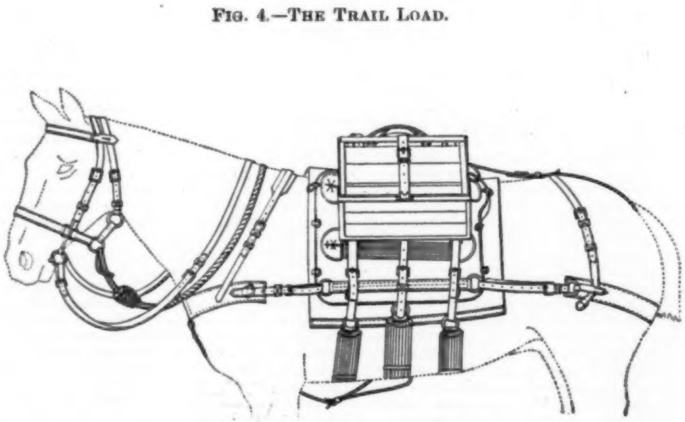


FIG. 6.—THE AMMUNITION LOAD.

FIGS. 3 TO 6.—75-MILLIMETER MOUNTAIN GUN CARRIAGE AND AMMUNITION PACKED ON MULES' SADDLES.

for raising the loads on or off the saddles. The breech and the muzzle of the gun are protected by leather covers.

	Lb.
Weight of gun complete with mechanism	236·0
Weight leather covers, breech and muzzle	2·5
Weight of crossbars	7·5
Weight of saddle complete with harness, picketing rope, bridle, head rope, reins and numnah	50·0
Total	296·0

In the cradle load (Fig. 3) the cradle is carried on the top of the saddle, and is secured there by straps; on the front part of the cradle there are strapped the shafts, each strap end being further supported by straps attached to the loin straps of the harness. Crossbars are also carried, one on each side, to facilitate unloading. Tompions are provided to prevent any grit entering the cradle during transport, and a mop is supplied for cleaning out the cradle before the gun is mounted.

	Lb.
Weight of cradle complete with buffer filled	194·5
Weight of one pair of shafts	28·0
Weight of two crossbars	7·5
Weight of tompions, mops, etc	8·25
Weight of saddle complete with harness, picketing rope, bridle, head rope, reins and numnah	50·0
Total	288·25

In the trail load (Fig. 4) the elevating gear and quadrant are attached to the trail, and all are carried on the top of the saddle and secured there by straps; on each side of the saddle there is slung a leather box containing the necessary spare parts and tools. On the left-hand side of the trail is carried the hand-spike, which is secured by means of straps.

	Lb.
Weight of trail complete with elevating gear	218·75
Weight of hand-spike	5·75
Weight of tools in leather boxes	4·5
Weight of saddle complete with harness, picketing rope, bridle, head rope, reins and numnah	50·0
Total	279·00

In the axle and wheel load (Fig. 5) the axle is strapped onto the top part of the saddle, and the wheels are carried as side loads on specially constructed hangers supported by the hooks on the arches of the saddle-tree. The hangers are made in the form of pivots representing the axle arms; onto these pivots the naves of the wheel are placed and secured by drag washers and linch-pins, thus providing for a sound and reliable support for the wheels. The wheels are further secured by two load girths. A pair of drag ropes are carried on the top and the two brake ropes are carried one on each side of the saddle.

	Lb.
Weight of axle	45·75
Weight of wheels	142·00
Weight of drag ropes and break ropes, etc	19·00
Weight of one pair of hangers	20·75
Weight of saddle complete with harness, picketing rope, bridle, head rope, reins and numnah	50·00
Total	277·5

In the ammunition load (Fig. 6) the cartridges are packed in ammunition carriers constructed of brass tubes fixed in a skeleton steel frame. The interior of each tube corresponds with the chamber of the gun. By this arrangement the cartridges are fully protected during transport. Four of these ammunition carriers constitute one load, two carriers being placed on each side of the animal in hangers or cages, supported by the saddle-tree hooks, and secured by the load girths.

	Lb.
Weight of one pair of hangers	17·0
Weight of four ammunition carriers	39 0
Weight of 12 rounds of ammunition	172·0
Weight of saddle complete with harness, picketing rope, bridle, head rope, reins and numnah	50·0
Total	278·0

THE OPERATIONS FOR REMOUNTING.—And finally we may describe the operation of remounting the gun after it has been transported by the mules to some vantage point:

1. Put the axle in its place and lock it to the trail by turning the lever down till it reaches the stop.
2. The wheels with drag-washers and linch-pins are placed in their position on the axle.
3. See that elevating gear stands in the right position indicated by the arrows. Drop the cradle axis in the jaws or bearings provided for it in the front of the trail, then turn the axis handle forward till it is locked. Drop rear end of cradle onto the head of elevating gear quadrant and secure it with the pin.
4. Lay the cradle in horizontal position and see that the piston-rod handles stand vertically. Place the front collar of the gun on the bridge at the rear end of the cradle and push the gun right home, when the ends of the piston-rods will enter the holes in the lugs of the gun. Now turn both handles outward 90 degrees, pull down the catches and the gun is ready for firing.

Increase of British Preferential Tariff in Canada.—Consul-General Turner writes from Ottawa, March 24, 1900, that in a speech recently made before the House of Commons, the Minister of Finance stated that the preferential tariff on articles of British manufacture had been increased from 25 to 33⅓ per cent.

AUTOMOBILE OMNIBUSES FOR SERVICE IN CITIES.

IN France, quite a large number of public services are effected through automobile omnibuses and trains; but such services are suburban. In Paris, no attempts have been made in this line, if we except a large steam omnibus of the De Dion and Bouton system, which was run in the streets of the city for a few weeks during last year.

The Compagnie Générale des Omnibus, which is slowly changing the mode of propulsion of its tramway cars, has not as yet, we believe, seriously studied the question of mechanical omnibuses. The same is not the case in other countries, however. At Berlin, there has just been put in service, by way of experiment, an electric omnibus (Fig. 1) having a seating capacity for twelve passengers inside and standing room for six on the rear platform. The frame, which is of steel tubes, carries two Siemens and Halske motors, each of which actuates one of the hind wheels through the intermedium of a reduction gearing analogus to that of tramway cars.

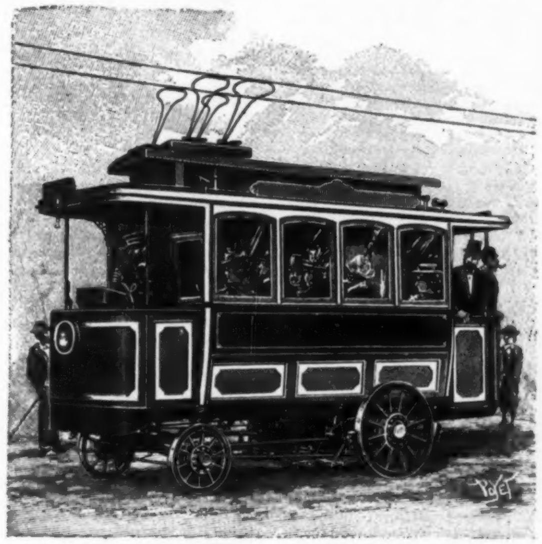


FIG. 1.—ELECTRIC OMNIBUS OF BERLIN.

The battery is recharged during stops from the overhead trolley wires.

The battery of accumulators, which is placed under the seats, consists of 44 elements of the Pollak type, and is sufficient for a trip of from 9·5 to 11 miles. Such small capacity, which would, at first sight, seem to be inadequate for a city service, is fortunately compensated for by an ingenious system of resupply. The omnibus carries upon the roof four current collectors that permit of recharging the accumulators during stops by simply borrowing the current from the city tramways. This prevents the battery from being discharged beyond its limit and assures its preservation.

As may be seen from the figure, the center of gravity is very low in order to assure great stability. The total weight of the vehicle in running order is 7,700 pounds and when fully loaded, about 5 tons.

The builders of this vehicle have likewise on trial an omnibus analogus to the preceding, but capable of being run at will, either upon an ordinary road or upon the rails of tramways. In the latter case, it takes the electric energy for charging its battery from the overhead trolley wire.

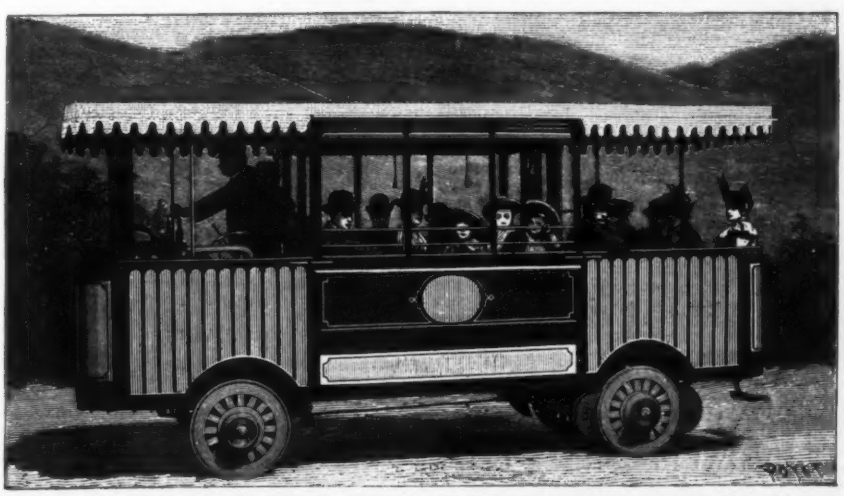


FIG. 2.—IRGEN'S STEAM OMNIBUS WITH FRONT-HAULER.

In September last, a gasoline omnibus service was inaugurated at London, between Kensington Gate and Victoria Station, by way of the Westminster Bridge. The vehicles, which accommodate 12 persons inside and 14 upon the roof, are provided with 12 horse power Daimler gasoline motors with 4 cylinders and of the Panhard and Levasser type. Their speed varies from 5 to 12 miles an hour. At the present time this service is limited, to two vehicles only.

Last summer, in the vicinity of London, and especially at Bedford, a line of public conveyances was started, the vehicles in use being 12-passenger open breaks driven by Daimler motors, as in the case before mentioned.

Attention should be called, along the same lines, to the fact that Norway, the picturesque and classical country of the Stokjärre—light two-wheeled Tilburys without a top—does not intend to fall behind.

M. Irgens, of Bergen, has just completed the steam omnibus shown in Fig. 2, which is quite original in design. He has endeavored to construct a symmetrical type of vehicle without falling over the æsthetic stumbling-block of the horseless carriage, by concealing the machinery and giving the machine the greatest possible stability.

The omnibus is propelled by the forward pair of wheels. Steam is furnished by a water-tube boiler in the front end, and a triple-cylinder engine drives the vehicle, the principle dimensions of which are as follows: Length, 17·32 feet; width, 5·64 feet; wheel base, 9·44 feet; tread, 5·31 feet; height, 8·72 feet; diameter of wheels, 28 inches; speed, 9·93 miles per hour on a level road.

STANDARDIZATION OF AUTOMOBILE BATTERIES.

By JAMES K. PUMPELLY.

CONSTANT complaint is made to the effect that the storage batteries of electric automobiles are uncertain in their action, rapidly deteriorating and losing their efficiency. This criticism is unfair and unjust—one that manufacturers of storage batteries take very much to heart; but it must be confessed that thus far the use, or rather, I should say, the misuse of the batteries has led the public to feel justified in its complaint. I insist, however, that a better knowledge of this very willing electric horse—a better understanding of how to treat it and feed it—would remove most of the prejudice. The fault, I think, begins with the designer of the batteries, and also lies against the makers of the vehicles. Neither the battery nor the vehicle is, as a general thing, adapted to the possibilities of the work to be done; in fact the two pieces of mechanism are generally planned on hazardous estimates.

A battery, to be efficient, should be economical. I mean by "economical" active enough and enduring enough to pay back with good percentage, in work, all it has cost. The battery itself, as it is now made, will do all this, but it must be made to fit the vehicle and also the work it may be called upon to do. If one were buying a horse for general use on uneven roads, but looking for a fair average of speed, he would not select a small or weakly proportioned animal. The same plan of selection should obtain in buying a battery.

This is difficult at present, because the purchaser of an electric vehicle knows little of the different kinds and sizes of batteries, and the makers of the carriage part not much more. The carriage maker depends on certain manufacturers of electric motors for part of the work, and on certain well-advertised makers of storage batteries for another. The motor maker sells a stipulated horse power motor, guaranteed to do certain work. How economically it will do it is not named in the sale. The manufacturers of batteries, well known through advertisements, sells a set of batteries of size and weight stipulated by the carriage maker. The different parts are thus put together, forming a very handsome vehicle—unless a cab is the vehicle planned; then handsome is not the word at all; rather a word expressing the opposite.

Now comes the crucial point—practical road work. A few weeks may show distressing weakness somewhere, disappointment and discomfort to the purchaser and reflex disappointment on the part of the makers of the different parts. The builder of the woodwork knew what weight of batteries his vehicle was to carry, but he did not know what kind of roads his work was to be subjected to; and the same may be said of the battery man, who knows that his battery will give a certain output in watts or horse power day in and day out, for a year at least, on fair even roads. The battery man also knows by experience that if only a fair average of work is called for, and good treatment, according to directions, is given the batteries, the purchaser of the carriage, as far as the battery goes, will be pleased and ride comfortably for many months.

But the fact remains that many important points in building the vehicle have been guessed at by the makers of the different parts. One need not continue to give reasons why disappointment and disgust come to the purchaser who has lost his money without the anticipated fast rides. The same result would ensue if horse and wagon were joined together to do work too great for the endurance of the one or the strength of the other.

This sort of haphazard work is being done all the time and all over the country where electric vehicles are being made and sold. Now, to prevent this sort of guesswork, why should not the automobile clubs joining with the manufacturers of storage batteries, seek to establish standard sizes and weights for each class of electric vehicle? Let such sizes be numbered. For instance, a No. 1 vehicle might be a carriage in the 1,200-pound class, calling for 42 cells of a certain size and weight; No. 2, weighing 2,000 pounds, calling for a battery of such and such size. The size is, of course, important to be standardized, because the floor space in the carriage is generally of arbitrary or fixed dimensions.

If such standards were established and known the manufacturer of batteries could have a stock of them on hand, 42 in a set, to fit a stipulated number of vehicle. He would then know, when an automobile manufacturer wrote to him, ordering at once a No. 1 or No. 2 battery, that a battery was needed to propel a carriage of a certain established weight and driven by an electric motor of known horse power and efficiency.

Having these standards, the rubber jars could be ordered in advance to fit each number. Cheap labor could be taken advantage of to manufacture battery plates. Time could be given to test, by two or three charges and discharges, each set of batteries sent out, and any weak points could be eliminated in the factory. This would lessen the cost of batteries greatly and raise their reputation. One reason for the high price of batteries for automobile work is the uncertainty of the market for any particular make. Again, knowing the standard dimensions of the vehicle and its weight, any improvement in batteries themselves, to render them lighter and stronger, would not necessitate a change of space or alter the woodwork of the carriage.

It is not at all a hopeless matter to make a much lighter battery without any of the weaknesses heretofore seen, and I, for one inventor and manufacturer, can say with confidence that such a battery will soon be ready for the market. When it is understood that 50 per cent. of the energy charged into a battery is absorbed in carrying or propelling the weight of the battery itself, anyone can see the necessity of lightness, if durability is not sacrificed. Hence, six amperes to the pound, as advertised in large batteries by some manufacturers, is not a sufficient output, if it needs three amperes to the pound to propel itself. Nor will weight of lead, for the sake of a little longer life in a battery, make up for the increased cost of wear and tear in the supporting and running parts of the vehicle.

The public must have something like fair commercial prices placed on the electric automobile, and much of this will depend on the cheapness, lightness and durability of the battery.—Western Electrician.

Pearl Fishing in Sierra Leone.—The Department has received from Consul Williams, of Sierra Leone, under date of February 2, 1900, a copy of a recent enactment creating a monopoly for the right of pearl fishing in the waters of the colony. The provisions read, in substance:

It shall be lawful for the governor in council from time to time to grant an exclusive right to any person for any period not exceeding five years to search for and gather pearls in all or any of the waters of the colony which are of 4 fathoms and greater depth, and also to grant to any person during such period the exclusive right of using diving apparatus in such waters for the purpose of searching for or gathering pearls.

Every such grant shall be made upon such terms and conditions and subject to the payment of such royalty (if any) as may be deemed expedient, and when made shall be published in the Sierra Leone Royal Gazette.

All apparatus and appliances imported by a licensee or sublicensee under this ordinance for the purpose of searching for, gathering, or preparing pearls may be admitted free of customs duty.

During the period specified as aforesaid, it shall not be lawful for any person to search for or gather pearls in any of the protected waters of the depth aforesaid, without a written license from the Crown licensee interested therein; and any person who shall during such period search for or gather or attempt to search for or gather pearls in such waters and without such license shall be guilty of an offence against this ordinance.

SELECTED FORMULÆ.

Preparations for Cleaning Gold and Silver Ware.—The Journal für Goldschmiedekunst gives the following formulæ for preparations for cleaning and polishing gold, silver and plated ware:

GOLD WARE.

Acetic acid	2 parts.
Sulphuric acid	2 "
Oxalic acid	1 "
Jewelers' rouge	2 "
Distilled water	200 "

Mix the acids and water and stir in the rouge, after first rubbing it up with a portion of the liquid. With a clean cloth, wet with this mixture, go well over the article. Rinse off with hot water and dry.

SILVER WARE.

Make a thin paste of levigated chalk and sodium hyposulphite, in equal parts, rubbed up in distilled water. Apply this paste to the surface, rubbing well with a soft brush. Rinse in clear water and dry in sawdust. [Note. Well levigated, not precipitated, chalk should be used for this purpose. Some authorities advise the cleaner to let the paste dry on the ware, and then to rub off and rinse with hot water.—Editor National Druggist.]

SILVER COIN.

Make a bath of 10 parts of sulphuric acid and 90 parts of water, and let the coin lie in this until the crust of silver sulphide is dissolved. From 5 to 10 minutes usually suffice. Rinse in running water, then rub with a soft brush and castile soap, rinse again, dry with a soft cloth, and then carefully rub with chamois.

SILVER-PLATED WARE.

Into a wide-mouthed bottle, provided with a good cork, put the following mixture:

Cream tartar	2 parts.
Levigated chalk	2 "
Alum	1 "

Powder the alum and rub up with the other ingredients, and cork tightly. When required for use wet sufficient of the powder and with soft linen rags rub the article, being careful not to use much pressure, as otherwise the thin layer of plating may be cut through. Rinse in hot suds, and afterward in clear water, and dry in sawdust. When badly blackened with silver sulphide, if small, the article may be dipped for an instant in hydrochloric acid and immediately rinsed in running water. [Larger articles may be treated as coins are—immersed for two or three minutes in a 10 per cent. aqueous solution of sulphuric acid, or the surface may be rapidly wiped with a swab carrying nitric acid and instantly rinsed in running water.—Editor National Druggist.]

GILT BRONZE WARE.

If greasy, wash carefully in suds, or, better, dip into a hot solution of caustic potash, and then wash in suds with a soft rag, and rinse in running water. If not then clean and bright, dip into the following mixture:

Nitric acid	10 parts.
Aluminium sulphate	1 "
Water	40 "

Mix. Rinse in running water.

BRITANNIA METAL.

Rub first with jewelers' rouge made into a paste with oil, wash in suds, rinse, dry and finish with chamois or wash leather.

INK STAINS ON SILVER—TO REMOVE.

To the foregoing from the German journal noted, we add a few useful processes picked up in personal experiences.

Silver articles in domestic use, and especially silver or plated inkstands, frequently become badly stained with ink. These stains cannot be removed by ordinary processes, but readily yield to a paste of calcium chloride and water. Javelle water, when at hand, may be used instead.

EGG STAINS.

These are easily and quickly removed from silver by rubbing with common salt. A pinch taken between the thumb and finger and rubbed on the spot with the end of the finger will usually remove the darkest egg stain.

TO CLEAN SILVER ORNAMENTS.

We have not tried the processes given above for cleaning silver, but the following we can endorse: Make a strong solution of soft soap and water, and in this boil the articles for a few minutes—5 will usually be enough. Take out, pour the soap solution into a basin, and as soon as the liquid has cooled down sufficiently to be borne by the hand, with a soft brush scrub the articles with it. Rinse in boiling water and place on a porous substance (a bit of tiling, a brick, or unglazed earthenware) to dry. Finally, give a light rubbing with a chamois. Articles thus treated look as bright as new.

TO FROST POLISHED SILVER.

Articles of polished silver may be frosted by putting them into a bath of nitric acid diluted with an equal volume of distilled water, and letting remain for a few minutes. A better effect may be given by dipping the article frequently into the bath until the requisite degree of frosting has been attained. Then rinse and place for a few moments in a strong bath of potassium cyanide, remove and rinse. The fingers must not be allowed to touch the article during either process. It should be held with wooden forceps or clamps.—National Druggist.

Mastic Furniture Polish.—Stockmeier states that ordinary French polish to which a small quantity of gum mastic is added answers every purpose of the more costly preparation. He suggests the following formula:

Gum mastic	65 parts.
Shellac	250 "
Alcohol (95 per cent.)	1,000 "

Since only perfectly limpid solutions answer for high grade polishing, the alcoholic solution of the gums should be shaken up with about one-tenth of its volume of benzine, and the latter drawn off after the mixture has been allowed to stand for a few hours.—Druggists' Circular.

TRADE NOTES AND RECEIPTS.

For Pulvis Equorum the Serbian Military Pharmacopœia gives the following recipe:—Nat. sulfurici, 200; Sulphur sublim., 100; Antim. sulph. nigr., 100; Pulv. Juniperi, 100; Pulv. Fœnicul., 100; Pulv. rhiz. Calami., 100; Pulv. rad. Gentian, 100.—Drogister Zeitung.

For polishing metals the following mixture is used, according to Die Werkstatt. Heat 8 to 9 parts of stearine, 32 to 38 parts of mutton grease, 2 to 2·5 parts of colophony, 2 to 2·5 parts of oleine until thinly liquid, add 48 to 60 parts of finely powdered Vienna lime, allow to cool with stirring, and keep the polish in well closed cans.

A liquid grease to serve as a rust-preventative coating can be easily prepared by melting lard and adding about an equal volume of oil of turpentine. The covering on metal acquires some hardness and a certain gloss, if a little linseed oil or varnish is added to the fat solution. It is also recommendable to dissolve rubber waste in the oil of turpentine; whereby, likewise, a tough coating is obtained.—Die Werkstatt.

Gilder's Wax for Fire Gilding.—Gilding wax, as it is used for fire gilding, consists of:—

1. Yellow bee's wax, 32 parts; finest red bole, 3 parts; aerugo, 2 parts; and powdered alum, 2 parts.

2. Yellow bee's wax, 96 parts; zinc sulful. pulv., 48 parts; and powdered borax, 15 parts. The dry ingredients must be very finely powdered and thoroughly dessicated before being added to the molten wax. Receipt 1 is for dark shades, No. 2 for light ones.—Journal der Goldschmiedekunst.

Substance for Sharpening Razors.—Melt one kilo of beef tallow and pour ¼ liter of oil to it. To this mixture, which is uniformly combined by thorough stirring, add in the same manner 150 grammes of washed emery, 100 parts of tin-ashes, and 50 grammes of iron oxide. The stirring of these ingredients must be continued until the mass is cool, as otherwise they would be unevenly distributed. The leather of the strop is now rubbed with this grease, applying only small quantities at a time. This renders it possible to produce a very uniform coating, since little quantities penetrate the fibers of the leather easier.—Rathgeber.

An excellent coating for steel, imitating the blue color of natural steel, is composed of white shellac, 5 parts; borax, 1 part; alcohol, 5 parts; water, 4 parts; and a sufficient quantity of methylene blue. The borax is dissolved in water, the shellac in alcohol. The aqueous solution of the borax is heated to a boil and the alcoholic solution of the shellac is added with constant stirring. Next add the blue color, continuing to stir. Before this coating is applied to the steel, e. g., the spokes of a bicycle, the latter are first rubbed off with fine emery paper. The coat is put on with a soft rag. The quantity of pigment to be added is very small. By varying the quantity a paler or darker coloring of the steel can be produced.—Technische Berichte.

Regarding sassafras oil, which is principally obtained from the root-rind of the sassafras tree, the results of recent researches are at hand, according to which this oil has a great resemblance in its composition to camphor oil. It has already been attempted to replace the sassafras oil by the oils obtained as by-products in the refining of camphor. Same are also extensively employed in soapmaking.

The branches of the sassafras contain another volatile oil, which was obtained from fresh twigs in a quantity of 0·028 per cent. Freshly distilled, it has a yellowish-green color, passing gradually into reddish brown. It possesses a specific gravity of 0·873, the optical rotatory power being $+ 6° 25'$. Its odor differs materially from the sassafras root oil, and reminds of lemon and citronella oils. As a matter of fact the oil from the twigs contains ingredients of these oils, viz., citral, $C_{10}H_{16}O$, and geraniol, $C_{10}H_{18}O$. Besides, linalool was found, and acetic acid and valerianic acid esters of the latter and of geraniol are also present. Hence, this volatile oil may be used for perfumery purposes. Furthermore, several terpenes as well as a paraffine-like substance with a melting point at 58° C. were found.—Zeitschrift für Kosmetik.

Ageing of Timber by Electricity.—The Nodon-Bretonneau process, which is said to impart to timber all those qualities which it formerly only attained by long storing, is founded on the Daniel experiment, which anybody can readily execute. Into a glass tube bent up at both ends, pour acidulated water, and submerge in it a drop of mercury. Next, the tube is placed exactly horizontal and left alone. When the wires of a battery are now placed in the two end openings, the quicksilver drop will be seen to move from the positive pole to the negative one. In the same manner the sap is driven from the wood to one side by the electric current, and finally expelled. This is done in a large wooden vat, in which a frame overlaid with lead forms a double bottom and is connected with the positive pole of a dynamo, over the wide apertures of the frame, which can be moved in a vertical direction by a hydraulic worm, the timbers to be treated is piled up. Over this, square boxes of small height, whose bottom is formed by felt and linen, are placed, which filled with water, represent porous vessels, as it were. By lead fittings the water receptacles are connected with the negative pole of the source of electricity. The vat is now filled with the liquid chemical preparation, which, gradually entering the wood is to crowd out the sap or rather to replace it. The wood piled up in the vat is not completely covered up by the chemical liquid, so that a space of several centimeters remains between its surface and the felt bottom of the water receptacles. By means of a current of steam running through serpentine pipes fitted at the bottom of the vat, the chemical liquid is constantly kept at a temperature of 30 to 40° C. The electric current passes through the whole thickness of the timber, between the frame surrounded with lead, over which they are piled up and the porous water receptacles standing on top. Under the action of the current, an endosmose as it were, takes place in the timber, by the chemical preparation entering the pores of the wood and crowding out the natural sap, which makes its appearance on the surface of the chemical liquid. The operation is finished in a few hours. The timber thus treated is allowed to dry in the open air for a few days, and the drying is completed in chambers with graduated temperatures. Immediately after leaving the chamber the wood may be worked up.—Neueste Erfindungen und Erfahrungen.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Germany's Future Food Supply.—The debate now in progress in the German Reichstag over the proposed meat-inspection act, as proposed by a special commission of that body—which, if enacted, would practically stop all importation of live cattle and meats into Germany after the year 1893—has brought into revived prominence the question which has for years weighed on the heart of German economists. What will the industrial and commercial classes of this country do for food in the event that, by reason of war or some artificial prohibition inspired by the Agrarian party, the imported supplies of breadstuffs and meats should be practically cut off?

Conservative statesmen of agrarian tendencies, says Consul-General Frank H. Mason, of Berlin, are fond of pointing backward to the good old times when the German States raised substantially their whole supply of bread and meat, and they assert that if the vast sums now expended each year for imported food materials were spent for fertilizers and in improving and increasing the flocks and herds of the Fatherland, the old-time independence could be re-established. Without presuming to discuss the soundness of this general proposition, it may be of interest to examine briefly some of the conditions which have led to the present annual deficit in home-grown food products, and what the proposed independence of imported supplies would involve. The question of food supply has of course, a direct and unavoidable relation to that of population. Can the products of the farm, the diary and garden be augmented until they overtake and thenceforward keep pace with the steady increase of population, which, under modern scientific sanitation and improved conditions of living, is growing at a pace which neither war nor emigration nor other adverse influence can more than feebly counteract?

During the past century, the population of the territory which now constitutes the German Empire has increased from about 20,000,000 to 56,000,000 souls—that is, has nearly trebled. A similar rate of increase would give Germany at the close of the twentieth century a population of nearly or quite 100,000,000. How is this vast multitude to be fed, not only a hundred years hence, but during the next twenty or thirty years? On this point, the teachings of past experience, although inconclusive, are not without a suggestive interest.

At the recent centennial anniversary of the Agricultural High School of Berlin, Prof. Max Delbruck stated in a formal address that during the past hundred years the agricultural products of the present territory of Germany had nearly quadrupled. Scientific culture and fertilizing, skillful drainage and rotation of crops, improvement of seed and freedom from the destruction and waste of local wars, have operated so favorably that the increased production per acre during even the past ten years has been 19 per cent. for rye, 10 per cent. for wheat, 3 per cent. for barley, and 25 per cent. for potatoes. How much higher the productiveness of German soil can be pushed by such intensive methods as are within the reach of the average farmer, which will not raise the cost of his crop beyond all reasonable relation to both its value in the world's market and to the ability of the German people to buy it for food, is the vital but unknown element in the calculation.

But, while good husbandry has done much, and may yet do more to increase the products of German agriculture, there has been, as Professor Delbruck sorrowfully admits, a vast and increasing diversion of these products to other than life-sustaining purposes in the form of food. Nearly the whole of the barley crop is malted and used for the manufacture of beer, potatoes and maize in vast quantities are devoted to the production of alcohol, and the best lands of Germany are now devoted to the culture of beet sugar, the greater portion of which is exported. It is true that the rough refuse of the breweries, the distilleries, and sugar mills can be utilized to some extent as food for animals; but there is no disputing the fact that these three forms of manufacture neutralize to an important degree the food-producing power of German agriculture.

And so, notwithstanding all improvements in farming processes, notwithstanding duties and all other obstacles thrown in the way of food imports by agrarian influence, Germany imported during the past year 1,370,850 metric tons of wheat, 561,251 tons of rye, 259,147 tons of oats, 26,216 tons of buckwheat, 23,787 tons of beans, 58,872 tons of peas, 1,104,349 tons of barley, 1,626,595 tons of maize, 214,139 tons of potatoes, 143,730 tons of fresh fruits, 11,761 tons of butter, 47,961 tons of pork meats, 21,752 tons of beef and veal, besides fish, dried fruits, and other luxuries in large quantities.

No discussion of this subject would be complete which did not take into account the vastly improved condition of the German peasantry and industrial classes during the past fifty years, and their greatly increased requirements in respect to varied and costly forms of food. The peasant of a century ago—the period of the Napoleonic wars—ate little except black bread and potatoes, and in many cases he had barely sufficient of them to sustain life. Meat was a luxury beyond the reach of the majority of the people. What were then luxuries have become, through universal education and progressive enlightenment, necessities of daily life. So that, although the century has seen the products of German soil nearly quadrupled while the population has been trebled, there is to be deducted the vastly increased loss of material through brewing, distilling, and sugar exports, and, in addition to this, there is the fact that the 56,000,000 people of Germany to-day demand and consume food products probably six or seven times more in market value than the plain fare of their 20,000,000 progenitors of a hundred years ago.

Finally, it is conceded that any really important and permanent increase in the home-grown food supply of this country will require the employment in farming of both capital and labor which are now more profitably engaged in the industries and trade which have transformed Germany during the past thirty years from an agricultural into an industrial and commercial nation. It is not enough that the land must be more liberally fertilized, but the throng of bright, energetic young men of the rural districts who now flock from the communal to the industrial, technical, and commercial schools and thence into factories and counting houses, both at home and abroad, must be turned back to the drudgery of the farm. Can this be successfully done? Can the agrarians, who promise, if protected from the cheap food products of America and Australia, to furnish the future food supply of Germany, make farming so attractive that it will retain the best brain and brawn of coming generations and attract the capital that now earns such abundant profits from industry and trade? Can the vast food import of the Empire be cut off or even largely diminished by artificial restrictions without provoking reprisals from which the now flourishing foreign commerce of Germany, which has been built up with such splendid energy, skill and foresight, would wither and decline?

The harvest of 1899, which was of rather more than average abundance in Germany, yielded, according to Professor Delbruck, 5·9 centners of rye, 7·5 centners of wheat, 6·85 centners of barley, and 49·9 centners of potatoes per hectare, which would equal, approximately, 262 pounds average per acre of rye, 334 pounds of wheat, 329 pounds of barley, and 2,221 pounds per acre of potatoes. At these rates Germany produced in 1889 4,323,542 metric tons of wheat, or 77 kilogrammes (161·7 pounds) per head of population, leaving, as already stated, a deficit of 1,370,850 tons to be filled by imported wheat, of which 710,318 tons came last year from the United States and 252,203 tons from Argentina.

Considering the high value of good farming lands in this country and the large outlay that is necessary for fallow crops and fertilizers, the question is asked whether chemical science, which has done so much for German agriculture, can not by some new method provide sufficient nitrogen at a cheap rate to restore the worn fields of the Fatherland and greatly increase the present yield of cereals. If this be possible, could the industries and through them the foreign commerce of Germany stand the severe and prolonged strain that would be caused by the general advance in the cost of food which would inevitably follow any serious attempt to cut off imported supplies, and render the growing of breadstuffs and meats sufficiently profitable to satisfy the agriculturists who now advocate such a policy?

These are, in brief, the basal elements of the problem into which the class of German economists who think of to-morrow are seeking to delve. Conflicting interests and ambitions, the struggle for life which modern inventions and social progress serve only to complicate and intensify, have brought the Empire—in respect to certain large details of policy—to the parting of the ways, and it is felt by thoughful people that the legislation of this year will have a potent influence in shaping the economic history of Germany for many years to come.

Agricultural Implements in China.—I am in receipt of a communication from leading manufacturers of agricultural implements in Illinois, requesting me to send a list of dealers in agricultural implements in Chinkiang, with a view to the introduction of these articles into this portion of China, says William Martin, United States Consul at Chinkiang. There being no such dealers in Chinkiang—the agricultural conditions not warranting such—I request the Department to publish my reply to the Illinois people in Consular Reports, and thus, perhaps, save our manufacturers of agricultural machines and implements a good deal of useless expense and labor.

Farming is not carried on in a large way here. Farms ranging from half an acre to five acres constitute the large and small holdings; it is clear they do not require reapers, mowers, thrashing machines, or steam plows. The Chinese dead seem to have preemption rights over all the hills and hillsides, leaving only the plains and valleys to the living—even these are encroached upon by the coffins of past generations.

The people build dikes of mud, inclosing, say, half an acre each, often making them from 3 to 6 feet high, to receive and retain the spring rains. Into the water they go, men, women, and children, and work until their little farm is planted in rice. Most of their time after the spring rains are over, is spent in treading the carrier pumps or bringing water and pouring it on the rice plants until the harvest time comes. I have no doubt hoes, rakes, shovels, and cheap hand rice hullers would find a market here, for the American implements are as far ahead of what they use as a diamond is superior to a sandstone.

The localities where wheat or barley is raised have farms about the same size. The plow is a light affair made of a crooked stick, with a steel point fastened to it, and is pulled by a water buffalo, a kind of half-breed between Texan cattle and the Western buffalo. Because he loves to wallow in the water, with his nose, eyes, and ears above that element, he is called water buffalo. When he is used for plowing, they attach a rope to the machine and slip a loop around his neck; being powerful and the plowing being shallow, he pulls the plow with the rope on only one side. They plant wheat just as we would plant corn; they do not sow it. As it begins to show above ground, they gather up all the human excrement they can, mix it with water, and scatter it over the growing grain or vegetables to force their growth.

When harvest time comes, men and women take a blade, inserted in a short handle at an angle of about 45 degrees, and proceed to cut the grain, bind it carefully, and carry it to the thrashing floor near their buildings. This floor is a hard, beaten spot of ground about 20 feet in diameter. The water buffalo, muzzled and attached to a stone roller, tramps and rolls the grain out of the ear. After the thrashing is done, they throw wheat and chaff in the air and allow the wind to blow the chaff away. When the wheat is thus winnowed, they gather it up, put it into bags, and pound what they need for use in a stone mortar.

I think scythes, small hand thrashers, fanning mills, and some cheap apparatus for grinding would find a large market here in time.

German Company for Sale of Agricultural Machines.—The Department has received a communication from Consul Barnes, of Cologne, dated February 5, 1900, in regard to the formation of a company for the sale of agricultural machines and implements at that city. The prospectus of the company sets forth that agricultural industries in Germany have been crippled by the tendency of the farmers to move to the cities and by the unwillingness of those who have been in military service to return to occupations in the country. The demand for labor in factories, etc., is very large in the present season of prosperity, and the farms are thereby depleted. The result has been that landowners are buying agricultural machinery more largely than heretofore, especially in the Rhenish and Westphalian provinces. The financial condition of the farmers in these sections is good, and there are also several societies to furnish aid to those who need it. It is intended to open sale and exhibition rooms at Cologne, goods to be sent on consignment. The concurrence and support of American and English manufacturers are desired. The consul thinks that the enterprise will promote American interests. The parties concerned, he says, are reliable. The prospectus and statutes of the proposed company are filed for reference in the Bureau of Foreign Commerce.

Glass Cutters' Strike in Belgium.—Consul Roosevelt writes from Brussels, February 9, 1900:

The glass cutters' strike at Charleroi, Belgium, remains stationary. In spite of the desire of a majority of the cutters to resume work, it is more than probable that they will allow themselves to be intimidated by the leaders of the strike. Manufacturers, on the other hand, announce their determination to put out the fires before submitting to the demands of the syndicate. It is anticipated that not less than sixteen furnaces in the Charleroi district will be extinguished to-day, which means a reduction of one-half the ordinary production and a clear loss in wages of 850,000 francs ($164,050) per month. It is interesting to note that once a fire is extinguished, three weeks or a month must elapse before it can be rekindled. The cutters demand 5 per cent. increase in wages, reinstatement of strikers in all the works, and six months' contract, with provision that workmen of advanced age shall not be replaced by apprentices, unless unable to cut the manufactured glass.

Proposed American Warehouse at Calcutta.—Consul-General Patterson writes from Calcutta, January 25, 1900:

I am constantly receiving letters regarding the manufactures of the United States, inquiring how such manufactures can be procured, and requesting to be put in communication with our exporters. The imports into India last year amounted to about $270,000,000, and this is the great distributing point.

The National Association of Manufacturers of the United States is doing efficient and practical work in the way of extending the foreign trade of the United States by establishing warehouses at Caracas, Venezuela, and Shanghai, China, for the display and sale of goods made by members of the association. I have no doubt that if such a warehouse were established in Calcutta, with agents authorized to make sales, a very large trade would result.

Progress of Salvador Railway.—Consul Jenkins, of San Salvador, on February 21, 1900, says:

The Salvador Railway, running from the port of Acajutla, through Sonsonate to Santa Ana, will be completed to San Salvador about the middle of March next and will be opened for traffic in the beginning of May. Trains will run to Acajutla from this city in the morning, returning the same day, giving merchants the opportunity to transact their business in the port in one day. The present method is to take the early train to Santa Tecla, go by mule or coach to La Ceiba, and thence by rail to Ateqs, where a change of cars is made to reach Acajutla. Freight will receive one handling in lieu of two, and the bad treatment given goods in ox carts will be avoided.

Waterworks in Maderia.—Consul Jones sends from Funchal, March 12, 1900, pamphlets (in French) giving the plans for the proposed waterworks and sewerage systems of Funchal. Mr. Jones thinks that some of our contractors may wish to make a bid.

The price is fixed at 190,000 milreis ($205,200) for the waterworks and 170,000 milreis ($183,600) for the drainage system. The pamphlets are filed for reference in the Bureau of Foreign Commerce, where they may be examined by interested parties.

Mining Privileges in Japan; Patent Medicines.—Minister Buck writes from Tokyo, under date of March 3, 1900, that at the session of the Japanese Diet just closed there was a change in the mining regulation, by which the privileges of mining were extended to foreigners organized as juridical persons under Japanese law. This, adds the minister, may be regarded as a sign of a liberal attitude toward foreigners.

A bill for controlling foreign patent medicines was also passed.

Dues on Pulp Wood in Ontario.—Consul-General Turner writes from Ottawa, March 24, 1900:

In the local house of parliament at Toronto yesterday, the commissioner of Crown lands gave notice that the dues on pulp wood would be increased from 20 to 40 cents per cord on the 1st day of May next. This will be of interest to American owners of pulp-wood lands in the Province of Ontario.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

THE ROMAN FORUM.

THE following communication from Mr. Richard Norton appeared in The Times: A little more than a year ago I had the honor of writing to you on the subject of the excavations which had then been recently begun in the Forum of Rome. As it is not improbable that this work, which has been going steadily on ever since, will soon be stopped, at least temporarily, it may be of interest if I give a slight account of what has been accomplished in the meantime.

One important result attained has been proof of the complete incompetence of the earlier excavators. Nowhere had these workers completed their undertakings. They did not dig deep enough, an omission for which, by all sound rules of archæological excavation, there is no excuse. Worse, even, pieces of monuments of which the original position was easily discoverable had, in many cases, been heedlessly cast aside as though they were uncut blocks from a quarry. This was true of the metope of the Basilica Æmilia, mentioned in my former letter, and equally so of several of the lower blocks of the Arch of Augustus which have now been placed where they originally stood. Numerous pieces of the base moldings and cornice and balustrade of the Rostra have also been gathered together and put beside this monument.

Behind the Rostra, it will be remembered, there is a curved wall of porta santa marble which has been for a long time an archæological riddle. Not unfrequently it has been called the Græcostasis. This name served but as a working hypothesis against which lay all the balance of probability. A much more reasonable explanation has been suggested by Mr. O'Connor, one of the students of the American Archæological School.

When the earth within the curved wall was taken away remains of travertine steps were brought to light. Now there was in the Forum, as is clear from various passages in Cicero, a Tribunal Aurelii shaped like a theater—as to its exact position and character authorities disagree. From what Cicero says it can scarcely be questioned that this tribunal was close to the Temple of Saturn and to the Comitium, and that it was built about 75 B. C. As the construction under consideration does not belie this date and suits all the other requirements, it seems as though Mr. O'Connor's suggestion may have solved the riddle.

THE RUINS OF THE ÆMILIAN BASILICA.

Between the tribunal and the modern road two interesting discoveries have been made: 1. Early tufa drains constructed with a high continuous ledge along one side of the interior; the object of this ledge is not apparent. 2. The foundations of the Temple of Concord. On some of the foundation-stones are cut large archaic letters. In this immediate vicinity another monument, the Temple of Saturn, has been cleared, but nothing of especial import was discovered.

Results more interesting were attained toward the northern limits of the Forum; for here, just in front of the Arch of Septimius Severus, was found the much-discussed Black Stone, while, approximately opposite the Basilica Julia, the remains of the Basilica Æmilia were brought to light chiefly through the munificence of Mr. Lionel Phillips. Both of these events have previously been mentioned in your columns, and the excitement occasioned by these discoveries has now died down to an extent which renders it possible to consider them without controversial animus. The Black Stone is, in truth, several black stones, or rather thick slabs, of black marble, making together a thick pavement some 12 feet square. The marble is of very fine grain, intensely black in color, lit by lightning-like streaks of white. It came, perhaps, from Laconia. Whether this Black Stone marks, as, according to certain ancient authors a certain black stone (niger lapis) in the Comitium did mark, the tomb of Romulus is for many obvious reasons open to doubt; but there can be no reasonable question that the black stone which has been found, and which is in the Comitium, marks the spot where, according to popular fancy, Romulus or Faustulus his guardian (for the story was told in different ways) was buried. When first found it was by some asserted not to be black. This opinion was due to color-blindness. Sceptics further asked to be shown the bases on which, according to the ancient account, sculptured lions had stood on either side of the Black Stone. Objections of this kind are tantamount to a proposition that excavators must find everything mentioned by the ancients before any of their statements are worthy of credence. Shortly afterward, however, these bases were found some 4 feet below the Black Stone, thus showing that the present Black Stone is to some degree a restoration and not the original form of the monument. Still unsatisfied, the doubters argued that not one but many black stones had been found, thus refusing to the Romans the right to refer in the singular to an object composed of several parts. But now the discussion is abating, and competent authorities seem rapidly becoming willing to acknowledge the Black Stone.

THE "BLACK STONE" SAID TO MARK THE BURYING-PLACE OF ROMULUS.

The results of the excavation below the Black Stone aroused even more discussion than the stone itself; for there, in addition to the bases of the lions above mentioned, were found a truncated cone of tufa set on a neatly-squared base, and a four-sided shaft, or cippus, of tufa rising from a base of its own. The meaning of the truncated cone is a riddle. On each of the four sides of the cippus and along one edge, which had been cut down to afford extra space for letters, were inscribed words the meaning of which is not yet certain. Whoever attempts to decipher these words is met by a two-fold difficulty; in the first place they belong to the earliest, as yet little understood, stage of the Latin language, and in the second, the upper portion (perhaps half) of the cippus was at some unknown time destroyed. The general drift of what is left shows, as has been proved by Comparetti, that the inscription dealt with the making of sacrifices. The sacred character of the spot where it was placed is clearly shown by the layer of ashes, bones and votive objects found all round the cippus. The most interesting of the votive objects were a small number of little bronze figurines strongly resembling the Apollo of Tenea. These are about 3 inches high, and, to judge from their style, were certainly not made in Rome or the neighborhood. Roman may be, on the other hand, two or three bone figures and a rudely-modeled, shock-headed nude male figure of bronze holding a short curved stick in his hands. None of these figurines are more than 4 inches high.

Foreign students have made but timid ventures toward deciphering the inscription, and it may be well to utter a warning against the numerous Italian interpretations. The above-mentioned article by Comparetti is well worth reading, but the rest, including those by

GENERAL VIEW OF THE EXCAVATIONS.

the gentleman whom his opponents wickedly dub the "glotologist," Ceci, may be completely disregarded. This energetic savant has fumed, insulted and raved by turns against the entire learned world, which refuses to attach any importance to his lucubrations.

Though the Comitium has been cleared as far back as the front wall of Sant' Adriano, nothing of great importance has come to light, except the larger part of a building inscription of the Republican epoch. This inscription is of considerable value to epigraphists, owing to the excellent preservation of its remaining parts and to the forms of letters employed.

The chief interest of archæologists was, however, concentrated upon the exploration of the site bought by Mr. Phillips and given by him to the Italian government. On, or rather under, this site the Basilica Æmilia was known to have stood, and notwithstanding the ravages of the Renaissance architects it was hoped that considerable remains of this very important building would emerge from their long burial. Even if the results of the excavation have not fully corresponded to the hopes previously entertained, the value of Mr. Phillip's munificence must not be underrated. It was displayed at a time when work in the Forum seemed likely to cease for lack of funds, but the stimulus afforded by Mr. Phillip's gift enabled Prof. Baccelli, Minister of Public Instruction, to obtain supplementary grants and to carry out further important undertakings.

The results attained on the site of the Basilica should not be disprized. The original plan of one side of the building (a long colonnade with rooms behind) can be made out, but the superstructure has, like most of the buildings in the Forum, been destroyed by vandalism. The plan is not quite what was expected; something more like the Basilica Julia, a rectangular space with colonnades on all sides, was looked for. Further exploration more to the north behind the wall which forms the back of the colonnade will probably reveal the expected central space with another similar colonnade. The plan of the ends has still to be made out. Two points are made clear by the great length of the building—1, that the Argiletum, the street that ran from the Forum past the Curia to the north, must have been extremely narrow; 2, that the well-known drawings by San Gallo and other Renaissance architects of Roman-Doric remains which have so often, though against many probabilities, been asserted to be designs of parts of the Basilica can in no easy way be brought into relation with it.

The colonnade was built of white marble shafts set in travertine foundations; architrave and frieze were also of marble, but the wall at the back and the spur walls that divided the space into chambers were of tufa. In some of these chambers are considerable remains of charming pavements in opus sectile. From a metope decorated with a patera, it seems that the metope with a boucranion found last year is a sample not of the whole but of only a part of the decoration. Other decorative pieces, attached originally probably to the walls, as in the case of similar bits in the Pantheon, were found in an ancient sewer which, running under the Sacred Way from the vicinity of the Basilica of Constantine, joins the Cloaca Maxima not far from the Basilica Æmilia. They are panels of white marble, some 4½ feet by 2½ feet, on which are carved, within a leaf molding, acanthus scrolls, from the centers of each of which spring a lion, panther, or other animal. They are magnificent examples of decorative work of the early empire.

The Basilica was restored, it appears, probably in the time of Theodoric. The original site of the building was not adhered to in all its parts, small shafts of red granite, raised on pedestals, taking the place of the earlier columns of marble. These granite columns were more numerous as well as smaller than those of marble.

Among the odds and ends found were two interesting inscriptions, one of these (much broken, though the pieces are well preserved) being the notification of a dedication by the Senate to Lucius Cæsar, written with all the splendid elegance of form of the inscriptional writing of the Augustan age. The other is a fragment of the Fasti, brought from the Regia and used as a threshold. Though much worn there are still to be traced the words recording the appointment of a dictator, "clavi fingendi causa," an interesting ceremony spoken of by Livy.

The Regia, whence the latter inscription came, has at last been laid bare. The ground plan was well known from earlier works by Nichols and others. Now, besides a well and an underground chamber, beehive shape, have been disclosed the foundations of what may well have been the shrine in which were preserved the sacred spears of Mars. It has been suggested that the beehive chamber was the sacrarium of Ops Consiva, but this sacrarium was entered on certain occasions by the Pontifex Maximus and the Vestals, and we can scarcely think of their descending into this dark, small hole. In this chamber were found some seventy ivory stili and a small wooden writing tablet. The well above mentioned was of no great interest, though it contained a few dice and astragoloi, and near it was found a bit of molding inscribed with the word Regia. The number of wells of all epochs that have been found is quite remarkable and all the earlier ones are characterized by having at the bottom a layer of gravel. As a layer of this same gravel was found under the Black Stone, and as, wherever it has been found, votive objects have come to light, it seems as though it had probably been used in some religious ceremony.

The Domus Publica, which belongs to the same group of buildings as the Regia, has been studied, but nothing new found except the corner of the impluvium, which gives, of course, a key to the plan.

The Atrium Vestæ, another building of the same group, has been more carefully worked over than ever before. The careless, or rather stupid, character of the earlier excavations was shown when, on the removal of the dirt from certain chambers at the southwest corner of the atrium, two rich pavements of opus sectile were uncovered. Following indications on the wall of one of these rooms of an original arched opening, blocked up at some later time, Signor Boni was rewarded by finding concealed in a small hidden passage-way a hoard of about 400 aurei of the late Roman Empire. Though well preserved, they were unfortunately mostly of common types of the reigns of Anthemius, Valentinian III., Livius Severus, Marcianus and Leo. The only rare ones are a few of the reign of Euphemia. Another and still larger hoard of coins, but unfortunately this time of copper, badly oxidized, was found a few days ago in the Basilica Æmilia.

As a sort of bond connecting these scattered explorations has been the search for the Sacred Way. Signor Boni, following the line of the sewer in front of the Basilica Æmilia, dug in front of the Basilica of Constantine, and there several feet below the late road that Lanciani had mistaken for the Sacred Way found extensive remains of the fine polygonal pavings of the real Sacra Via. Higher up toward the church of S. Francesca Romana he came across the foundations of the Porticus Margaritaria, and then digging below the nave of the church itself he found the same pavings, thus proving that originally the Sacra Via ran straight from the Forum toward the site where the Colosseum was subsequently erected. Later, perhaps when Hadrian built the Temple of Venus and Rome, the Way was turned toward the Arch of Titus.

These, then, are the most important results of the year's work. Others less noteworthy, such as the laying bare the marble door of the Forum Pacis and the finding in other parts of Rome of a bit of the Ara Pacis and 500 or more fragments of the Forma Urbis, have been described in the official publications. It is a year that will long be remembered. It is a year when what Americans term the "horse sense" of an Englishman won for the world of scholars a victory over false sentiment, and when that same world has applauded the well-founded strictures of Prof. Helbig upon the management of the Papa Giulio Museum. If the fates permit Minister Baccelli to remain in office there is every reason to hope that the good work of the past twelvemonth will be continued, if not in the Forum itself, at least in other parts of Rome.—Our engravings are from Die Illustrirte Zeitung.

THE GERMAN NAVAL ACADEMY AT KIEL.

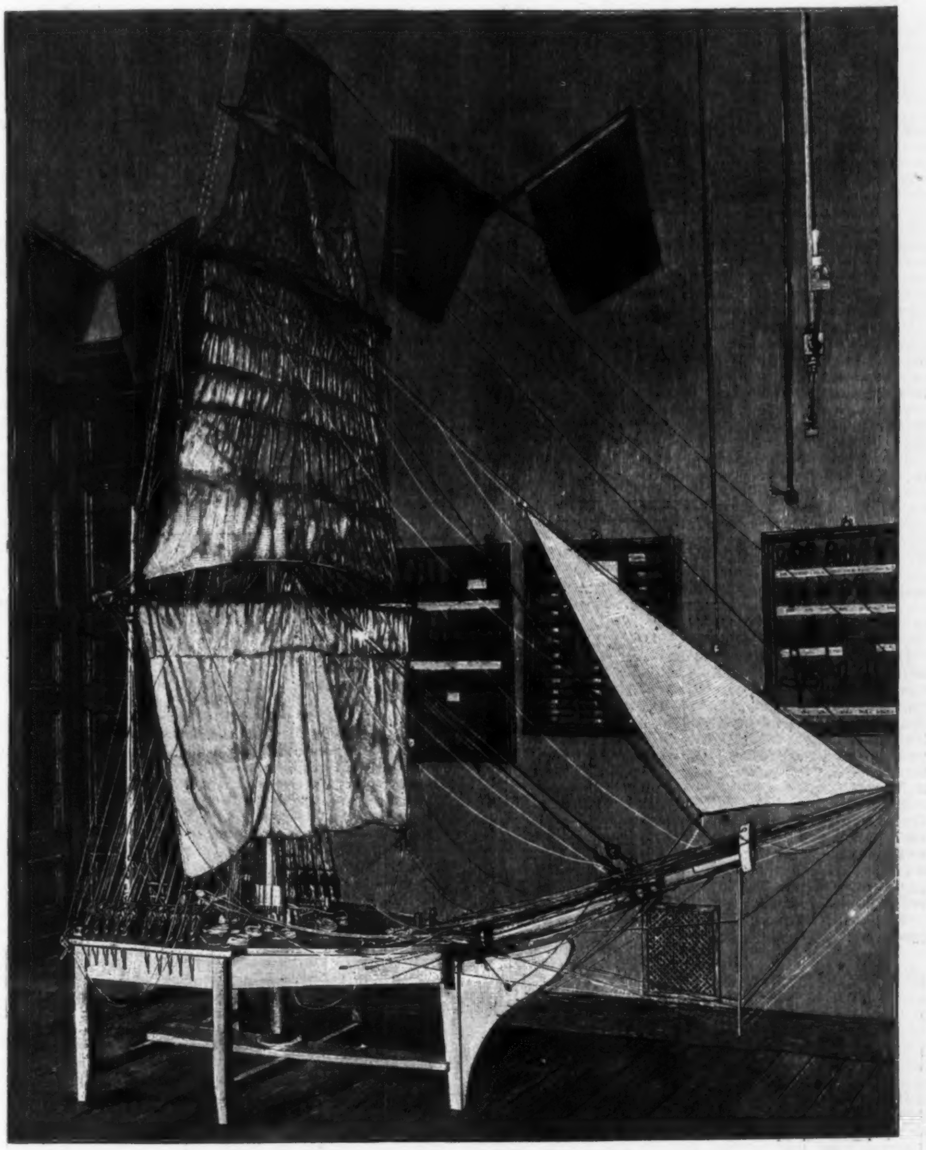
THE officers of the German navy, before they enter the service of their country, receive an education at the naval academy at Kiel, which, in thoroughness, is in every way equal to the training received by our own men at Annapolis. The Kiel Academy is one of the most elaborately equipped naval institutions in Europe. Every conceivable facility is provided for instructing the men in navigation, naval architecture, and naval warfare. The academy has a model room, which contains a most excellent and complete collection of charts, compasses, and sounding apparatus, besides the usual models of vessels of a bygone day. In the various lecture rooms, physical, chemical and other scientific apparatus is to be found for the use of the instructors in teaching and of the students in experimenting.

One of the first lessons which the cadet must learn is the name of every sail, rope and block of a full-rigged ship, as well as the making of the various hitches and knots used by sailors.

For this purpose a model is used, which, as our illustration (reproduced from Illustrirte Zeitung) shows, consists of a stand provided with a completely-rigged foremast and bowsprit. Not a single block or rope is missing.

The life which the men lead at Kiel is not one of ease and luxury, although it has its pleasures as well as its pains. The cadets sleep four in a room in the dormitories in the upper stories. A table, a bed, a chair, a washstand, and a closet are all that the government allows a cadet. If he wishes to have a sofa and an armchair, he must pay for these luxuries out of his own pocket.

In summer he rises at 5:45 o'clock, and in winter at 6:45 o'clock. At 7:30 o'clock he is called to breakfast. At 8 o'clock he begins work. At 11 o'clock he has a light luncheon. And after a recess of half an hour he continues his work uninterruptedly until 3 o'clock. Dinner is served at 4 o'clock. The rest of the day he can devote either to pleasure or to study.



MODEL USED AT THE GERMAN NAVAL ACADEMY.

SHIPPING AND SHIPBUILDING IN THE UNITED STATES.

By JAMES W. ROSS.

THE building and use of ships were employments which the founders of the American Colonies and their descendants may be said to have adopted naturally, and from the middle of the 17th century to the middle of the 19th, shipping and shipbuilding were two industries whose competition England especially dreaded. In fact, in 1650, the English Parliament felt it necessary to enact a statute for the purpose of protecting English shipping against her Colonies of America, and no less than twenty-nine other similar statutes were passed during the following one hundred and twenty years.

Notwithstanding these restrictions shipping continued to grow in spite of all efforts on the part of Mother Country to the contrary, and at the time of the outbreak of the Revolution shipbuilding was the leading industry in New England. During the eight years from 1788 to 1797 shipping increased three hundred and eighty-four per cent. but this remarkable increase was exceptional, and was due to the almost

universal state of war existing in Europe at that time which threw the carrying trade of the world into our hands. From 1807 to 1837 was a period of decrease in our shipping, and was followed by a second great rising period culminating in 1861, when the maximum tonnage of the United States at any one time in its history was reached, being at that time 5,539,843 tons, while that of Great Britain was 5,895,369 and the combined, tonnage of all other nations, at that time, amounted to 5,800,967 tons. The aggregate tonnage of the United States in 1861 was, therefore, but little smaller than that belonging to Great Britain, and being less than 300,000 tons smaller than that of the rest of the world.

The following table, taken from the report of the Commissioners of Navigation and the records of the Treasury Department, shows the rise and fall of American shipping during the last one hundred years:

Year.	Tons.	Per Cent.
1790	346,254	40·5
1795	529,471	90·0
1800	657,107	89·0
1805	744,224	91·0
1810	981,019	91·5
1815	854,295	74·0
1825	665,409	92·3
1835	588,173	84·5
1845	904,476	81·7
1855	2,348,358	75·6
1865	1,518,350	27·7
1875	1,515,598	26·1
1885	1,262,814	15·3
1895	822,347	11·7

The above statistics show to what a great extent our shipping has fallen off, particularly since 1861, when our foreign tonnage reached its highest point, until, in 1895, it was but little more than one-third as great as in 1861, and over 150,000 tons less than it was eighty-five years before, or in 1810. This startling decline is shown still more clearly when we compare the per cent. of imports and exports carried by our vessels. Our ships having carried 91·5 per cent. of our foreign trade in 1810, and but 11·7 per cent. in 1895, or a falling off of about 80 per cent. While that of Great Britain, in 1880, was 6,574,513 tons registered. The aggregate British tonnage being somewhat over 16,000,000.

Our entire tonnage, both sail and steam, decreased from 5,539,813 tons, in 1861, to 4,057,734, in 1881, and 4,-769,020, in 1897, showing a considerable fall for the first twenty years, followed by a slight increase thereafter. Iron steam vessels having slightly increased in total tonnage since 1861, while there has been a slight decrease in the aggregate tonnage in sailing ships for the same period.

The vessels built in the United States since 1880, in tons, are as follows:

Year.	Tons.
1855	583,450
1860	233,194
1880	157,409
1882	282,269
1886	95,453
1891	369,302
1895	111,602
1897	232,232

In 1856, the tonnage built in Great Britain was 935,-000 tons, and in 1880 it had reached 7,903,000 tons, or nearly nine times as great as in 1856, while that of the United States for the same period was but little more than one-fourth as great as in 1855. The tonnage of iron vessels built in the United States from 1876 to 1881 was 127,298 tons, that of Great Britain over 2,000,000 tons. Of the tonnage built in 1897, 124,394 were of iron and steel.

The total tonnage of all vessels, foreign and domestic, entering our ports in 1870 was 6,270,198 tons, and in 1897 had increased to 20,002,639 tons, of which but 3,611,176 tons were American. These figures, of course, do not include our tonnage on the lakes and rivers of the United States, but merely those vessels engaged in ocean commerce.

The total tonnage built on the Great Lakes since 1880 was:

Year.	Tons.
1880	22,890
1881	73,504
1886	20,400
1891	11,856
1895	36,353
1896	108,782
1897	116,937

Of the total carrying power of the world, 8·4 per cent. is carried in American ships, while British ships carry 56·6 per cent. The newspapers of Hamburg, the third largest commercial port in the world, said, in 1897, that thirty years had elapsed since that port had seen the stars and stripes at a masthead. No merchant ship flying the United States flag passed through the Straits of Gibraltar or the Suez Canal in 1895 or 1898.

It is only in the deep sea navigation, across the ocean or to South American ports below the Orinoco, that our shipping interests are weak. American ships carry now about one-half of the total sea commerce between the United States and neighboring foreign countries, as Canada, the West Indies, Mexico, Central America, and the northern coast of South America. Our domestic water commerce, coastwise, Great Lakes, rivers and canals, is by far the largest in the world and is two and one-half times greater than that of the United Kingdom, second on the list.

The primary cause of the decay of shipping and shipbuilding may be termed a natural one, the result of the progress of civilization; namely, the substitution of iron and steel for wood, and steam for sail as a means of propulsion. So long as ships were built of wood we had an advantage over other nations, in the cost of material and in the skill and working of the same, and also in the skill of managing wooden sailing ships; when, however, steam was substituted for sail and iron for wood, these advantages were in a great measure neutralized or wholly swept away.

Another cause put forth for the falling off of American shipping and shipbuilding is the duties on shipbuilding material in the United States and the navigation laws. It is true that the navigation laws were enforced at the time of our greatest importance in the shipping world during the early part of the present century, but at the same time all other maritime nations had similar codes, which have since been repealed or greatly modified, except in the case of the United States. From 1816 to 1840, the shipping of Great Britain remained almost stationary, but when duties were removed it increased immediately, and still more so when the navigation laws were repealed in 1849. Another cause for the decline in shipping is said to be the excessive fees charged ships entering the United States ports for pilotage, health fees, tonnage duties, etc., which amount to a great part of their revenues.

On the other hand there are those who take the opposite view of the case and argue that the navigation laws and duties on ship materials were the very cause of our prosperous shipping trade at the beginning of the present century, and that as soon as these were all modified, as in the case of the reciprocity laws, our trade fell off. On the whole, though it seems more probable that the falling off in our shipping was not greatly affected by these measures, either one way or the other, and that the chief causes of the decline were the changes that took place in shipbuilding, thus throwing the advantage of skill and cheapness of production into the hands of the British, who were better able to use the new materials than we were.

For over a century and a half shipbuilding in the United States was limited to the construction of wooden vessels, and their sole means of propulsion was by the use of sails. But the beginning of the 19th century was destined to make the first great change in shipbuilding in this country, for with its coming came the introduction of the steam engine as a new means of propulsion. This new and wonderful motive power was first successfully applied to ships in this country by Robert Fulton, whose "Claremont," built in 1807, was the first successful steamboat in the world. The "Claremont" was a side-wheel steamer, 133 feet long, and it is said to have attained a speed of five miles per hour on her trial trip from New York to Albany. The following years were marked by the building of a number of other steamboats of a similar type, most of which were employed on the Hudson River, between New York and Albany. In 1814 appeared the first steam war ship ever constructed. This vessel, built by Robert Fulton, and known as the "Demologos," was constructed in 1814, and consisted of two hulls joined together with a canal in the center for the paddle wheel, and is said to have steamed at the rate of five miles and a half per hour. The "Demologos" was never used in battle and her value as a fighting ship was, therefore, never ascertained.

The first steamship to cross the Atlantic was the "Savannah," built in New York in 1819, and crossing from Savannah to Liverpool in twenty-five days. This trip, however, was not accomplished entirely by the use of steam, for the "Savannah" was also fitted with sails and the paddle wheels were so arranged as to be folded on deck during favorable winds and the sails used, so that steam was employed only during weather unfavorable for the use of sails.

The great drawback at this time for the use of steam as the sole motive power was the great amount of fuel necessary to carry a vessel across the Atlantic, it having been estimated that more than four times as much coal was necessary to each horse power as is required now; for this reason it was many years before steamships were sufficiently perfected to make it possible for them to cross the ocean under steam power alone. The "Great Western," a British ship, making the first trip in 1878, from Bristol to New York, in fifteen days.

American steam shipping, however, did not assume any great proportion until 1848, but from that time it increased so rapidly that in 1851 it was practically equal to that of Great Britain. In 1850, the first American line of steamships to compete in the transatlantic trade known as the Collins' Line was established. Four ships were built, the "Arctic," "Baltic," "Atlantic," and "Pacific," being larger and swifter than any other ships afloat and having vertical bows, the first of the kind ever built. For a time this line was the finest in the world, but disaster seemed to follow the company, two of their ships being sunk, one of which was never heard of again after starting on her trip across the Atlantic. Some few years later the company failed.

Meanwhile other great changes had come about in the construction of ships, namely, the use of iron instead of wood. In 1834, the "John Randolph," built in England for a Savannah man, was the first iron ship ever seen in the United States, although the first vessel to be constructed of this material is said to have been built in Great Britain in 1818. The first large vessel to be constructed of iron was the British ship "Great Britain," built in 1843, and was also fitted with a screw propeller being the first ship of large size in which the screw had ever been used, although first introduced by John Erickson in 1836.

The next important change in shipbuilding came with the introduction of the compound engine or the old fashioned low pressure jet injecting type. With the old form of engine the great drawback to high speed was the great amount of coal required per horse power, and the impossibility of high pressure. The compound engine, to a great extent, changed these conditions, and together with the advancement in boiler making made a much higher pressure possible, with a great saving in the amount of coal required per horse power; it having been said that but $2\frac{1}{2}$ pounds were now required for each horse power where 4 had been necessary with the old form of engine, the compound engine was used in 1862, by the Cunard Line of steamships, and came into general use in 1874, when it was introduced into the ships of the Inman and White Star Companies.

But at about the same time the compound engine came into general use, a still great improvement made its appearance in the triple expansion engine. This new type was first used in 1874, but did not come to be generally adopted until about 1885. With its introduction came a still greater development of speed in steamships, owing to the higher pressure and to the further saving of coal, which was said to be as much as 20 or 25 per cent. less than the compound engine required. This wonderful improvement was followed a few years later by the quadruple expansion engine, making a still greater saving in the consumption of coal, at the same time making higher pressure possible, and, hence, greater speed. The "St. Louis" and "St. Paul," our two fast liners, are fitted with these engines, the first large ships to which the new principle has been applied.

Steel came to be used in ship construction about 1880, although not very generally adopted until some years later. Its introduction brought about a still greater improvement in shipbuilding, owing to the fact of its greater strength than is possessed by iron, hence a ship may, by its use, be made lighter and at the same time stronger than by the use of iron. Steel has not been used until within the last few years for the construction of merchant ships, but has been used almost from the time of its adoption, in 1880, in the construction of our ships of war.

Twin screws first came into general use in 1887, when the "City of New York" and the "City of Paris" were built for the Inman Line Steamship Company, and soon after the same principle was applied successfully to the White Star Line steamships "Teutonic" and "Majestic."

The system of multiple screws was still further enlarged upon about three years later, with the introduction of the third screw. This arrangement has been successfully carried out in the "Columbia" and the "Minneapolis," our two fast cruisers, and driven by three 3-cylinder vertical inverted, triple expansion engines, attain speeds of 22·81 and 23·073 knots per hour respectively on four-hour runs. The fastest time ever made by a cruiser.

The special advantage of triple screws are, smaller size of the separate parts of the machinery, enabling higher rotative speeds to be employed with safety, and greater economy than ordinary cruising when one engine working up to about its natural draught full power will give a fair cruising speed with economy of fuel. It is far from economical to run large twin screw engines designed for nineteen knots and upward at speeds of nine and ten knots. Engine friction alone forms such a large percentage of the power developed, to say nothing of the increased cylinder condensation due to the slower rotative speed, that the economic performance, as measured by coal per horse power, is very low. The total horse power being divided between three shafts also vastly decreases the chances of the total disablement of the ship.

In 1892 a bill was passed by Congress, at the proposal of Dr. Griscom, president of the International Navigation Company, admitting the "New York" and "Paris" to American registry on the understanding that two other ships of at least equal tonnage would be built in the United States. The two ships built according to the provision of this act, the "St. Louis" and "St. Paul," were launched in 1895. A short description of them may serve to show the state of advancement in shipbuilding in the United States, and further as an illustration of the most recent improvements in ship construction.

"St. Louis" and "St. Paul" are the largest ships ever built in the United States, and, with but few exceptions, the largest and most powerful of any ships in existence. These vessels are sister ships, 545 feet in length, 62 feet and 9 inches beam, and 42 feet and 4 inches deep, with a light displacement of 10,700 tons. The motive power is furnished by a pair of vertical inverted quadruple expansion engines actuating twin screws, to carry a working steam pressure of two hundred pounds, and capable of developing 20,000 indicated horse power. The ships themselves are built of steel, and every bit of material used in them is of domestic production. They are of American model and design, and were built by American skill and muscle.

When the act of admitting the "New York" and "Paris" to American registry, on condition of building two ships of equal tonnage in American shipyards, was passed, the British press ridiculed the idea. "Such ships could not be built in the States," they said; later certain naval architects from Great Britain visited our shipyards and saw such ships actually in process of construction. Now the British newspapers admit that our yards are capable of turning out ships equal to the product of any shipyard in the world.

"St. Louis" and "St. Paul" have proved to be all that was expected of them; safe, commodious, comfortable, luxurious, and fast; free from vibration and among the stanchest and ablest sea-boats afloat. A striking incident of the latter quality occurred in a recent passage, when the "St Louis" and "Campania," being abreast in a gale heavy enough to buffet and knock down the speed of the latter, the "St. Louis" plunged through it at nearly full speed without the slightest distress of discomfort.

The "St. Louis" and "St. Paul" have taken the passage record from New York to Southampton, "St. Paul" holding the westward record of six days thirty-one minutes, and the "St. Louis" the eastern record in six days, ten hours and ten minutes.

Having thus proven our ability to compete in the construction of passenger vessels with our British cousins across the Atlantic, let us now see how our ships of war compare with theirs. It has been but a few years since what is known as the reconstruction of our navy began. In 1882, the first of our present new navy, the "Atlanta," "Boston," "Chicago," and "Dophin" were, by Congress, authorized to be constructed. Since that time we have added over forty vessels of modern type, and with but few exceptions built of American material and by American workmen, and from American designs. We have now reached a point where we are able to compete successfully with any nation in the world, and, in fact, our ships are said by many to be superior to those built in British shipyards.

An eminent English naval authority, in an article published in The Fortnightly Review, July, 1894, compares our battleships of the "Indiana" class with similar ships in the British and French navies, and, after noting the size, speed and armor, says:

"It will be observed that the 'Indiana' and 'Iowa' compare unfavorably in speed with both 'Renown' and the 'Jaureguiberry,' but in almost every respect they seem to be immensely, nay, crushingly superior; and I do not regard great speed of supreme importance in a battleship. What, for example, could be the value in practice of the 'Renown's' superior speed as against the 'Indiana's.' It might, it is true, enable our ship to force an action, but with an opponent so greatly superior in gun fire our ship could scarcely hope, other things being equal, to achieve success.

"If the two ships, engaged bow to bow, stern to stern, or bow to stern, the United States ships could give blows much more numerous than those of the British ship, and in the aggregate nearly thrice as heavy; even if they engaged broadside to broadside the aggregate energy of the American fire would be much more than double that of the British. Put our huge 'Royal Sovereign,' or our coming 'Prince George,' as our champion instead of our 'Renown' and we will not fare much better, for the Americans distribute their guns much more advantageously than we do, and their battleships, which I have sighted, represent more sensible compromises of the rival claims of speed, radius of action, gun-power and armor than any of ours. If our battleships be unequal to the task of engaging another battleship of inferior displacement, superior speed will avail the former little, unless to enable her to run out of danger, yet is not the main object of a battleship after all to fight. In the war of 1812 we were obliged, much against our will, to take lessons from the United States on the subject of the proper way of gunning frigates. We might do worse now than take lessons from the United States on the subject of the proper way of gunning battleships; and, also, of gunning cruisers, for the American cruisers are as superior to ours as the American battleships are."

The chief cause, as we have seen, of the decline of our shipbuilding industry was the change from wooden to iron ships, thus throwing whatever advantage there had been in our favor into the hands of Great Britain, owing to the fact that the latter country was better able, at that time, to produce iron, and could do so more cheaply than was possible in the United States. But we have made such rapid progress in the iron industry during the last few years that we are no longer at a disadvantage in this respect, but, in fact, are able to produce iron and steel cheaper than it can be produced in Great Britain. We have not yet reached our maximum power in the production of iron. Our furnaces are much larger than those in Great Britain and of a more modern type, and with the vast amount of iron to be found in the United States, and the large amount of capital which may be employed in the iron industry, there seems to be no reason why we should not continue to produce iron and steel at the same, if not at lower rates than is possible in Great Britain. Another advantage we have is the cheapness of fuel. American coal is the cheapest in the world. The cost of production has generally decreased during the last few years. In 1880, the average annual output per employe was 190 tons; it is now about 550 tons. In 1882, the output of pig iron was 4,623,323 tons, and of finished iron and steel 3,500,000 tons. In 1887, these figures had reached 6,417,148 and 5,250,000 tons respectively, while in 1997 these figures were 9,652,680 and 7,000,000 tons.

American steel rails are now being supplied on contracts to British India, Russian Asia, and the West Indies, Canada, South Africa, Hawaii, and even to Ireland. In one month last year the two largest steel rail companies are said to have booked between them no less than a half million tons, the largest proportion of which was for export. Nor is this surprising, for the prices have steadily fallen during the last few years; thus, in 1896, the price of steel rails was $24.25 a ton in the United States, $26.80 in Germany, and $23.75 in Great Britain.

In 1898, the prices were $19.00 in the United States, and $28.75 in Germany, and $22.50 in Great Britain. In 1898, the exports of iron and steel from the United States amounted to $70,367,527 as against $57,497,872 in the previous year.

The London Statist, one of the principal financial journals of England, published not long ago, an article entitled "American Ships, Iron and Steel," in which, after dwelling at some length upon the rapid development of our iron industries during the last few years and making some prophecies in regard to our future positions in the shipping world, the following statement was made:

"The point we have sought to bring out is that America has now so developed her iron and steel industries that she must find fresh outlets for her products. Such outlets she is finding, as we believe, with profit in foreign markets, for certain products. For other products however, she will need to create a new shipbuilding industry of her own, and what has been done, or is being done in that direction, we must reserve for future examination. No thoughtful man, acquainted with the American character, who considers the situation, can fail to perceive that the greatest competition to be faced by British industry and enterprise in the future is that of American shipbuilding. It may be deferred a few years, but it is bound to come."

TELEPATHY AND TRANCE PHENOMENA.

By JAMES H. HYSLOP, Ph D., Professor of Logic and Ethics in Columbia University.

TELEPATHY, or Thought Transference, is one of the difficulties with which we have to contend in the study of trance phenomena and their interpretation, especially as reported in the Piper case, where the incidents are of that kind that make chance impossible, on the one hand, and exclude secondary personality of the ordinary type on the other. This means that the facts which play so important a part as at least apparent evidence for discarnate spirits are obtained unconsciously by some process of thought transference from one mind to another, if we are to exclude the possibility of a spiritistic origin. The fact of such a process seems to be adequately supported by a long series of experiments between normal persons, the results of which have been published in various reports of the Society for Psychical Research. But in the absence of any determinate limits to such a power, though experimental evidence does not extend it beyond the present active state of the mind, investigators of trance phenomena feel inclined or compelled to assume that it may have access to human memory, and in this way dispense with the influence of presence ideas. This is an extremely generous concession to make to the skeptic, but the facts seem to require it as a necessary precaution against hasty admission in favor of spiritism. The average scientific man is not yet disposed to admit telepathy of any kind, much less that it has any unlimited and selective access to the memory of the experimenter. But unless he admits it to the full extent of this supposition he has absolutely no defense whatever against the spiritistic hypothesis in any case of phenomena like those so laboriously investigated by the Society for Psychical Research. For in the Piper case the uniform testimony of experimenters is that there is no sort of correspondence or correlation between the present mental state of the sitter and the facts "communicated" until after the "message" is given. The facts almost universally represent incidents that belong either to the memory of the sitter or to that of some one else not present and unknown to the medium. Very rarely, if ever, is the idea in mind at the time. But in spite of the fact that science has not experimentally proven telepathy from the memory of the sitter or agent, we have deemed it prudent to assume the wildest possibilities in the case before yielding to any of the claims of spiritualism. Hence, unless the facts obtained in genuine trance phenomena are not known by the sitter, we have conceded, at least, a hypothetical difficulty which spiritism has to overcome before it can receive recognition.

In my own experiments with the Piper case this difficulty is met satisfactorily in a large number of instances. But before indicating them, or a few of them, it will be important to remind the reader again of the conditions under which the facts were obtained, as these are indispensable to the formation of any intelligent judgment about them and their value.

In the first place, the whole problem of fraud was thrown out of court by the most careful investigation as many as eleven years ago. In the second place, there is absolutely no resemblance in any important respects between the Piper case and those which form the peculiar conception of such phenomena. There are no physical trappings or darkness connected with the experiments. Everything is done in the light just as experiments in any university laboratory. Mrs. Piper is wholly anesthetic and unconscious, as was attested by the most thorough medical methods. The incidents that pass for evidence in the case are written by the medium's hand in full sight and on pads furnished by the experimenter. The importance of the "messages" depends wholly upon their content. Questions asked are directed, not to Mrs. Piper's hearing, but to the hand held by Mrs. Piper near the mouth of the speaker, and the answers are then written out. There were some 150 to 200 incidents given in this way, and which represented very definite facts in the lives of several "communicators," all, as well as myself, absolutely unknown to Mrs. Piper at the time.

Of those incidents which were unknown to me a few are the following: A "communicator," claiming to be my father, giving his correct name and relationship to me, asked me if I remembered the trouble with his left eye. I never knew that my father had any special trouble with either of his eyes. I had been separated from him ever since 1880, seeing him but a few times only after that date. But, on inquiry of my stepmother, I ascertained that my father suffered considerably with his left eye during the last year of his life, and frequently remarked the fact to her, and taking off his spectacles to ascertain the cause of the trouble. The circumstances is not mentioned in his letters to me during that time which have been kept. A more important incident was one that I first rejected as absurd. I had sent to Dr. Hodgson, who was holding several sittings for me while I remained in New York for the very purpose of shutting out direct telepathy, the name of an old neighbor of my father's. The object was to suggest the alienation that had taken place between the two men and with it any any other incidents that association might produce. The name I sent was Cooper. But I got for answer a lot of statements about some philosophic discussions with him, and the statements also that he had carried on some correspondence with the man. This I rejected as mere secondary personality. When I went on later to have some personal sittings the subject was spontaneously resumed by the "communicator" and mention of a school made in which this Cooper was interested, the indication accompanying some remarks about a trip to the West. This appeared to me as confusion worse confounded. But when I made inquiries in the West, not so much to verify the incidents as to ascertain why they could have been given, I found that Dr. Joseph Cooper, of Allegheny, Pa., was at one time a warm friend of my father, and that in all probability my father had carried on the correspondence mentioned at the sitting. I further learned, also, that on a trip in the West with my stepmother, in 1884, he had visited the Cooper Memorial School at Sterling, Kansas. Of all these incidents I was entirely ignorant. The personal friendship between the two mem had existed as far back as 1858, when I was only four years old, and was limited to correspondence on theological subjects, the two men meeting only at synodical assemblies.

A cousin "communicating" mentioned a book of poems in connection with the name of his sister, whom he called his aunt. When I made my personal inquiries in the West I found that she had read to him from a book each chapter of which ended with a long poem, and that all through his illness of six months he called her "aunt" in deference to the habits of his children, having nursed him in his sickness. I had neither seen nor heard from this cousin for two years before his death. In fact, I never had a letter from him in his life, nor in any way had communications from friends about him, except one short letter from an aunt informing me of his illness. He gave, also, the name of his wife's sister of whom I had never heard, and also the name of his son George in connection with that of a little dog that this son owned when he was three years old. An uncle, the father of his cousin, and who died in 1876, claimed to "communicate" and mentioned the name of his sister and the fact of her death. I had never known her by the name given and had not heard of her death, she having lived in another part of the State from my residence. He stated, also, that his father had been in the war. Three living sons denied the fact, but I found in the history of the county in which the man lived that he had been in the war of 1812, having been commissioned in 1810. Two other incidents mentioned by him were unknown to me.

The "communicator" claiming to be my father described the breaking of a cane about which I knew nothing. Also, when I asked if he remembered a certain neighbor whom I named and whose daughter had married my brother, he at once asked about the church in his old home, and added without further inquiry from me that "they had put an organ in it." When I got West I ascertained that this was a fact, and that this neighbor was one of two or three others who had left the congregation on account of the incident. He alluded also to a black skullcap which he said had been made by "Hettie's mother." Hettie, or Henrietta, is the name of my half sister, and was given her because there was considerable difficulty in getting the name of my stepmother correct. I found by correspondence that such a cap had been knit for him by my stepmother. He mentioned, also, a preparation of oil taken for his sickness. Of this I knew nothing, and the circumstances made it impossible to know it. In all there were some twenty-five or thirty such incidents "communicated" in this way and representing facts unknown to me.

But I cannot omit the importance of the five sittings held in my behalf by Dr. Hodgson while I remained in New York. The "communicator" in all of these purported to be my father. The results are very rich in facts, though not so much so as my own sittings. But all the facts given were absolutely unknown to Dr. Hodgson, and a considerable percentage of them also unknown to myself. The trouble with the left eye, the paper cutter, the breaking of a cane, the Cooper incident and several others were among these that I did not know and had to ascertain in the West.

These are all trivial incidents, but they are all the better for that fact. Personal identity cannot be established by any other method. The graver and more important features of the record from which I have drawn are not evidential. Science, however, must expect its criteria to be satisfied only by the presence of the most trivial circumstances, as these are the only things which are not likely to be duplicated in experience generally. Moreover, those who are familiar with the procedure of the courts in matters of evidence will recognize at once that trivialities are the most important aspect of circumstantial evidence. Besides, a system of experiments imitative of the Piper phenomena, and undertaken by myself, showed that intelligent men when left to their own devices spontaneously choose trivial incidents to establish their identity. Hence, when it is a matter of science, we have to dismiss the trivial character of the incidents which I here quote as evidence. We may well do this also when we remark that the facts chosen in my imitative experiments to prove identity did not give the slightest clue to the mental and moral condition of a single person out of the twenty-five or more engaged in them. I could easily indicate some of the "communication," which would redeem their character from the accusation of triviality, but they are absolutely worthless as evidence.

Now when it comes to the explanation of such facts it is clear that no ordinary mind reading or telepathy can account for them. We are entirely beyond chance in the case, especially when taking account of all the facts, and if telepathy is still to have any standing after discounting for the incidents that I can remember, we have to suppose that in the trance the medium can find the right person among all living consciousness and extract by telepathy the right incident to represent the personal identity of the same individual represented by the incidents taken from the sitter's memory. In some cases this person selected may not be known to the sitter, and in all of them he may not know himself whence the fact must be obtained. Now this is a supposition of enormous magnitude. There is no parallel to it in anything short of infinity. After telepathy by supposition has shown such marvelous selectiveness in its access to the memory of the sitter, it must be still more amazing to see it start on the hunt through the world for some appropriate person among all other living persons and proceed with the utmost ease to pilfer incidents for illustrating personal identity. There is nothing which such a power of extracting knowledge ought not to do. It certainly ought not to commit simple mistakes as it does, in regard to the incidents in the mind of the sitter. Any man who can believe in such a power without having demonstrated it in experiments that do not reproduce personal identity is a man who can believe anything. He ought not to find any credulity in the acceptance of spirits as at least equally explanatory of the phenomena.

We cannot hinder a man from accepting such an hypothesis if he insists upon it, but we have the right to ask him to admit the magnitude of it and to accept the logical consequences of his position, which are such as practically assert an infinite capacity for the human brain that is not attested by a single other physiological fact on record. The truth is also that many assume and assert telepathy without any knowledge of what it means and of what its legitimate function as a hypothesis is. It is legitimate as an instrument for raising the standard of evidence for discarnate spirits, especially when the phenomena to be explained do not furnish any indications of the personal identity of a deceased person. But it is a different matter when we are confronted with all the psychological unity of a real mind in the phenomena presented for explanation. Telepathy, as known by experiment, does nothing of the kind. But when once supposed to account for certain coincidences that require some cause, many assume a right to shout telepathy without regard to the fact that it is not a known cause even in the mind of those who first advanced it as an hypothesis. Much less has anyone the intelligent right to propose it when cornered, unless he has acquainted himself with the meaning of the term as indicated by present knowledge. It is not a name for any known cause, but only for the necessity of a cause which as yet remains unknown. Nevertheless, we have the right to press it as far as it is reasonable to do so in defense against our being fooled. But even when tolerating it in its wildest form we may as well acknowledge that its alternative has some claims to recognition, as at least equally reasonable. But it will not do to assume without proof other than phenomena purporting to be spiritistic that the human brain has such enormous capacities, and this is what the advocate of telepathy does not do. Most frequently he is a man who has not experimented on the subject at all, and is the victim of a priori conceptions and reasoning. I have known one case in which a man assumed that his having been the secretary of a very rich person qualified him to speak very confidently of powers in the brain for which there is not a single authority or fact in history. That is the kind of person who will

hold out for telepathy without the sense of humility or humor to see that his theory is larger than the one it supplants and that it demands explanation quite as fully as the phenomena it assumes to account for.

I do not regard such incidents as I have mentioned in my experiments as the strongest argument against telepathy to explain the Piper case. But they meet the popular demand that the facts must transcend the mind and memory of the person present at the sitting, and force the believer in telepathy to extend that capacity to the instantaneous acquisition of facts from all living minds, and only the pertinent facts at that. Whoever prefers this assumption, a priori as it is, to the possibility of the spiritistic theory must be allowed to enjoy his liberty.—The Independent.

THE TRAINING OF DOGS.

Everyone knows how to make a dog jump over a cane. The feat is not a difficult one, and it is rare to find an animal that will not perform it with willingness. Should the case prove otherwise, the allonge—a long rein used in training—must be employed, for the spiked training collar is entirely useless. For making an animal jump over a bar, the inclination for retrieving, possessed to a high degree by certain dogs, may be put to profit by throwing a stick over the obstacle.

After the dog has been trained to jump without hesitation and return to his place, he may be regarded as well under control and can be taught at least to do ordinary work. He may be at once set at jumping over bars arranged around a ring. The dog will soon learn to perform this trick from right to left, that is to say, in the direction he is going when the trainer, having the animal at his right, can urge him on with the whip; but he will learn how to do it not so quickly in the other direction.

A standing jump over a bar can be required only of

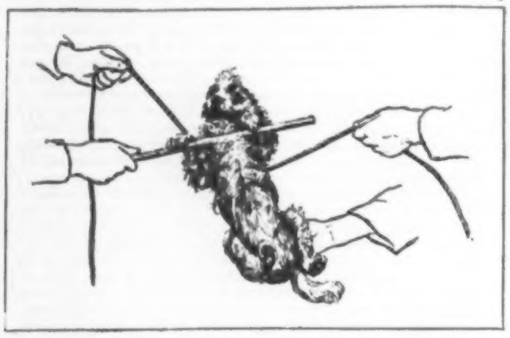


Fig. 1.—TEACHING A DOG THE BACKWARD SOMERSAULT.

subjects whose buttocks are exceptionally well developed. We shall speak further along of the conditions of equilibrium of an animal that is made to stand upright; and shall merely say here that this result once obtained, it is necessary to act in the same way before an obstacle with the standing dog as with the animal on all fours, that is to say, to employ the training collar and the allonge, taking care all the while not to keep the cord taut and thus give to the jumper a pull which would compromise his equilibrium.

Dogs are trained to jump the rope by making them leap toward it and then by passing it quickly under them. This operation is repeated until the animals get accustomed to jumping as soon as they hear the noise of the slapping of the rope against the floor. They perform this exercise either standing or upon all fours. For some years past it has been the fashion to employ two ropes. The trainer swings one of these

Fig. 2.—THE BACKWARD SOMERSAULT.

with his right hand and the other with his left. His assistant stands opposite him and holds the other ends of the ropes. This performance is no harder for the dog, however, as the two ropes pass under him in opposite directions not half a second apart, while he is making the jump.

By getting two dogs to jump over one another in succession, a reproduction of the game of leap-frog is obtained. In order that the exercise may proceed with regularity, however, the dogs must be prevented from walking between leaps.

In order to decide a dog to aid himself with the spring-board, he is either coaxed to ascend it, or is dragged upon it by means of a leash. Then he is forced to make a leap in order to pass over a bar placed in front of him and slightly raised. After this he is sent back to his place and immediately called to take his stand again on the board, with the bar held

Fig. 3.—THE ARABIAN JUMP.

in front of him. It is very rarely the case that he will sneak away. There are numerous varieties of the spring-board. The best form, which is elongated, and is about 28 inches in length by 18 in width, consists of a simple board padded and mounted upon four legs, the front pair 20 inches in length and the rear pair 6. After jumping, the "artist" alights upon a mattress, which serves to deaden the shock. When it is desired to train a whole pack to jump and to return to the starting point and begin over again, a long passageway extending from the bench to the mattress is employed. In this way, the dogs, after jumping over the obstacle, return outside of the passageway without interfering with those that are starting, and finally become so accustomed to doing this that the passageway

Fig. 4.—RENDERING A DOG'S LOINS SUPPLE.

becomes useless, and that calling them may be dispensed with. A continuous chain is thus established and the pack seem to leap altogether like the cascade of balls in the hands of a juggler. This performance, although very old, is one of the prettiest known.

The tricks that have just been described require on the part of the trainer merely the exercise of considerable patience; but there are some in which he reveals his imagination and especially his skill, such as the backward somersault.

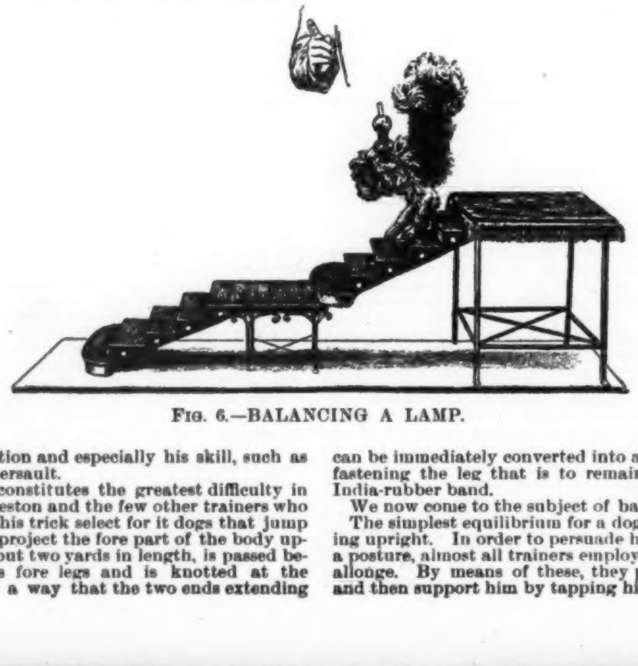


Fig. 6.—BALANCING A LAMP.

The somersault constitutes the greatest difficulty in dog training. Atteston and the few other trainers who are able to teach this trick select for it dogs that jump very straight and project the fore part of the body upward. A cord, about two yards in length, is passed behind the animal's fore legs and is knotted at the shoulders in such a way that the two ends extending beyond the knot shall have the same length (Fig. 1). Thus harnessed, the dog is placed upon a slightly padded carpet, and, while an assistant grasps one of the ends of the cord, the trainer grasps the other in his left hand, the dog's muzzle at the time being turned toward the master's right hand in which he holds a stick. The animal is then urged to jump over the latter. At the moment at which his fore legs touch it, the trainer and his assistant stretch the cord. Immediately after this, the animal's body is forced backward by means of the stick and is made to turn around the cord as an axis, the assistant aiding by pushing the hindquarters. It will be seen that as soon as the dog notices the earth beneath him when turning his head backward, his instinct of preservation will make him gather his legs together in order to finish turning. Later, he will attempt this motion as soon as he has jumped from the ground, and, in the first place, will fall upon his back, since he does not as yet know how to direct his spring. But, at the end of a few weeks of fruitless endeavors, he will succeed in placing his hind legs under the center of his body before jumping, in extending them abruptly, and then in immediately gathering them together in order to turn in the air and thus make a somersault (Fig. 2). There is also a German method (the one just described being American) that consists in employing the collar and leash as instruments of projection. The jump obtained in this case is never correct nor straight, and, moreover, the risk is run of breaking the animal's legs.

Whatever be the method brought into recognition, the object is always difficult to attain, and no one must expect to succeed before four or five months of good daily work. The daily practice is as fatiguing to the trainer as it is to the animal. Small dogs, as might be supposed, give less trouble than large ones. For the latter, it sometimes requires two assistants, and a strong trapeze suspended from the ceiling by ropes is substituted for the stick.

The somersault is sometimes complicated by making

Fig. 5.—A BURLESQUE OF THE PERFORMANCE OF ERMINIA CHELLY.

the dog jump from a raised support or even a pyramid of dogs provided with cushions. Miss Doré's Irish terrier Paddy, who is 9·8 inches high at the shoulders, turns a back somersault over a barrier 3 feet high, which is quite a wonderful feat.

The front somersault has often been tried; but jumping from the feet has had to be discarded and the spring-board employed. Upon giving an impulse to the body of the dog when he is in the air, trainers have succeeded in deciding him to plunge forward; but, after a frightful massacre, no one has, up to the present, obtained such a motion except in a very incomplete manner.

The Arabian jump (Fig. 3) is a side somersault with a start upon three instead of four legs—the two hind ones and one of the front ones. An ordinary jumper can be immediately converted into an Arabian one by fastening the leg that is to remain inactive with an India-rubber band.

We now come to the subject of balancing.

The simplest equilibrium for a dog consists in standing upright. In order to persuade him to assume such a posture, almost all trainers employ the collar and the allonge. By means of these, they place him upright and then support him by tapping him under the chin

with a whip. Some place the animal behind a small perambulator like that designed for children, and allow him to walk only with such an apparatus; but it is not advisable to attempt such a method of training except with dogs that have a natural inclination to stand. It is evident, however, that it may become necessary to place a dog upright when the animal does not take kindly to such a position. In this case an allonge may be employed; but a simple collar should be used in place of the spiked one employed by professionals.

To teach a dog to walk upon his fore legs requires much time. The trainer first renders the loins of his pupil supple by curving his body and rubbing his vertebral column (Fig. 4). Then he makes him jump over the whip. At the precise moment that the animal is about to fall back on the ground, he switches him gently from the bottom to the top of the belly and forces him to stand for a second upon his fore legs. Repetitions of this process end in giving him the ability to stand in such a position for a sufficient length of time. He can then be taught to waltz head downward, to climb a stairway in the same posture, and to throw himself from a stool, etc.

Dogs are taught to climb two ladders placed parallel or two spades provided with horizontal bars by giving their four legs strokes of the whip directed upwardly until the animals have taken refuge upon the top rounds.

The cylinder, of course, is easier to maneuver than the ball. Upon such apparatus the pupil assumes an equilibrium of himself. The fear of falling dictates to him the motions to be made, and these exercises, which appear so difficult to perform, do more credit to the dog than to his master. In order to expedite the training, the master may indicate the positions to be taken by causing the dog to shift the weight of his body to the side desired by means of the whip. The whip should never be placed upon the dog's body nor give him a bearing point.

Balancing in the hand does not constitute a serious difficulty. The dog, once accustomed to keep himself rigid, his loins curved, and his head bent toward his tail (the end of which is sometimes placed in his mouth), the trainer holds him at will upon the extremity of one of his fingers (upon two legs or even upon one), just the same as he would balance a ring or a bottle thereon. He throws him into the air, makes him turn a somersault, and catches him in equilibrium. This is a simple question of skill on the trainer's part, the dog being passive. But woe to the exhibitor who should fail in his part. He might have to erase this exercise from his programme, since he would have lost the confidence of his pupil, and confidence here does everything.

Miss Doré, the accomplished trainer, owns a poodle of wonderful docility which obeys the least motion of her eyes, and which, guided by a person concealed from the spectators, balances upon a horizontal rod placed in his mouth a rolling ball as well as an apparatus loaded with revolving plates and glasses. It ends its performances by throwing a ball into the air by means of a battledore held in the mouth. One of its companions waltzes upon its fore legs while holding a lighted lamp upon its head. Among Miss Doré's dogs there is a poodle possessed of a jaw of incredible strength. This animal, in fact, while standing erect, carries huge weights, a large cannon which an assistant fires, and a ladder to the summit of which a dog of medium height climbs. It is rare to find, as we do in this dog, strength of loins and jaws combined with a very pronounced inclination for retrieving. This latter is a great resource for people of the trade, who both use and abuse it. It is developed in young dogs by throwing to them some object that is neither too heavy nor too hard, urging them to pick it up, and giving them a piece of cake every time they bring it back. When the subject is already a good retriever, he is trained to pick up an object placed near him, at a snap of the fingers, and is corrected every time that he takes it into his head to pick up something placed farther off. In this way, it will suffice, with the aid of the leash, to habituate him to walk around numbers placed in a circle and pick out the one placed at his height at the moment that the fingers are snapped. Later on, the nature of the objects to be retrieved can be varied to infinity.

HYMENOCALLIS MORITZIANA, KÜNTH.

THIS species of Hymenocallis, although introduced to European gardens a few years ago, is as yet but little known to gardeners. It is a compact, handsome, evergreen plant, with erect, Eucharis-shaped leaves, 2½ feet in length, with petioles equally as long as the blades. The flowers are white, fragrant, with very long tubes of a greenish tint, green filaments and styles. They are borne in an umbel of twenty or more, and appear early in the year, opening successively in two's, the display being kept up for a fortnight. Individually they last about three days before collapsing. As in all species of Hymenocallis, the leaves and flowers vary in size on different plants, some of the forms of each species running so close to other species as to render their identification a matter of difficulty. The only species likely to be confounded with the one under notice is H. eucharidifolia (Baker), which is smaller in all its parts, and has a very stout neck composed of the sheathing bases of the alternately arranged leaves. The leaves of H. Moritziana are distichous, or nearly so. The treatment required by this plant is similar to that afforded Eucharis, but it must not be rested, as growth takes place at all seasons. In 1894, H. Moritziana was fairly common near the coast in Venezuela to the W. of La Guayra, at which place the plant illustrated was collected. We are indebted to The Gardeners' Chronicle for the engraving and article.

HYMENOCALLIS MORITZIANA—FLOWERS WHITE, WITH GREENISH TUBES, FILAMENTS, AND STYLES.

Nearly all of the members of the Russian Imperial family are enthusiastic automobilists.

REVIEW OF TRAFFIC QUESTIONS IN FRANCE.*

By C. COLSON, Ingénieur en Chef des Ponts et Chaussées, Councilor of State.

INTERNAL NAVIGATION IN 1898.

THE returns recently issued by the Public Works Department show that the growth of the internal navigation, which has been very marked during the last eighteen years, has again shown strides in 1898. The following figures enable us to compare the results of the last three years:

	Goods Carried.	Average Distance.	Total Number of Units.
1896....	29,534,000 tons	140 kilometers (87 miles).	4,191,000,000 ton-kilometers (2,563,000,000 ton-miles).
1897.....	30,609,000 tons	143 kilometers (88·9 miles).	4,386,000,000 ton-kilometers (2,670,000,000 ton-miles).
1898.....	32,527,000 tons	144 kilometers (87·6 miles).	4,577,000,000 ton-kilometers (2,790,000,000 ton-miles).

The total increase for 1898 is 4·8 per cent., while for 1897 it was no more than 4·2 per cent., and the average annual increase since 1880, when the great improvements in navigable waterways was commenced, has been only 4·8 per cent. But we must note that this last percentage was far ahead of the average increase on the railways during the same period, for this did not exceed 2·5 per cent. per annum on the average, while now, on the contrary, the railways are getting the upper hand, for the increase in ton-mileage amounted to 4·3 per cent. in 1897, and 7·7 per cent. in 1898.

Progress is, however, much more regular upon the waterways than on the railways. The latter are specially affected by all the ups and downs which alternations of prosperity and depression in trade produce in traffic. Waterways are at liberty to alter their rates so as to retain the traffic. Were it not for this, they would come to a standstill when traffic is dull; and they can always refuse what they have no room for, no matter what the requirements of the public may be. Railways, on the other hand, must not only charge fixed rates, without the right of trying to keep traffic by temporary reductions in times of depression, but also convey all traffic that offers within the legal limits of time, no matter how crowded their lines are. The result is, that since 1880, while navigation was gradually growing in proportion as the waterways became improved at heavy cost, the railways, after having had great difficulty in coping with the requirements of 1880 to 1882, showed a loss of 1,700,000 ton-kilometers (1,040,000 ton-miles) during the depression between the years 1883 to 1886. No sooner does a new era of prosperity set in than it is the railways alone who get blamed, because the rolling stock could not be increased fast enough to meet requirements, while every factory in the world was refusing orders. No doubt some companies were a little late in getting the necessary plant; but it is fair to say they possess a fair excuse in the fact that the increase in traffic by rail far exceeds at this moment what might have been expected from the experience of previous years, when the waterways absorbed a far larger proportion of the total increase.

The public is slow in comprehending that the division of traffic between two different methods of transport, one of which is quite at liberty to alter its charges, and consequently its share, as may suit it, while the other has to bear the brunt of the battle unassisted, injuriously affects the elasticity of the whole. Yet it is easy enough to see that as soon as a line, which under normal conditions has not got to carry all the traffic, has to cope with almost the whole bulk of unexpected extra consignments as sometimes happens, and even take traffic that usually goes by a competing route when this route is closed, owing to atmospheric conditions, the relative importance of the unexpected consignments, in view of shortage of rolling stock, becomes magnified. Since the year 1889, when the effects of the depression of 1886 had nearly passed off, until 1897, the number of tons conveyed one kilometer by rail increased, on the average, 380,000,000 (232,396,000 ton-miles) per annum, while those carried by water increased 140,000,000 (85,620,000 ton-miles). In 1898 the increase on the waterways was 211,000,000 ton-kilometers (129,041,000 ton-miles); that on the railways amounted to 1,064,000,000 (650,709,000 ton-miles). Accordingly, while the total increase of traffic amounted to nearly double the average of recent years, the increase by waterways only amounted to 50 per cent., but was trebled in the case of the railways; naturally the latter have greater difficulty in managing than if they were ordinarily prepared to carry the whole traffic. There is, moreover, little doubt but that when the next period of depression comes, the rolling stock they are now having built in haste will lie idle once again, while, by lowering rates slightly, the barges will be able to keep the traffic which they will have stolen from their rivals.

THE CANAL BETWEEN THE RHINE AND THE ELBE.

Readers of the Revue Politique et Parlementaire have been kept informed by the interesting articles from Dr. Montanu (June and September numbers) on the matter of internal navigation, which in Prussia has been the most important political question of the year. The rejection by Parliament of the schemes proposed by the Government, for the construction of a canal between the Rhine and the Elbe, has brought about the downfall of two ministers, a significant fact in a country where it is not on an adverse vote that ministers resign, and one that may well herald a change in the trend of imperial policy, till now highly favorable toward the conservative and agrarian party. A few remarks on the bearing of the scheme from a traffic point of view, and on the arguments put forward during the debate, will not prove amiss.

In the vast undulating plain which comprises North Germany, several great rivers act as splendid waterways for the transport of goods from north to south, and these have been rendered easily navigable by a few works that cost comparatively little. In the western part of Prussia, transverse canals connect the Elbe with the Oder, the Oder with the Vistula, and even the latter with the Pregel and the Memel by the use of the Kurische Haff, so that all the waterways in these parts of the country form a practically continuous network.

* Revue politique et parlementaire, November 10, 1899.

The portion of this network lying east of the Oder only carries on a relatively unimportant trade in timber and agricultural produce. But the Oder which connects Stettin harbor and the province of Brandenburg with the coal fields and manufacturing centers of Silesia carries, in its course of some 500 kilometers (311 miles), traffic which varies according to the section in question between one and two million tons and which will soon be carried further over the part higher up that has recently been canalized. The Elbe conveys on its 600 kilometers (373 miles) traffic which, starting with 3,000,000 tons at Schandau, where a portion consists of Bohemian lignite, reaches 4,500,000 tons above Hamburg. Between these two rivers, the network of canalized rivers and canals in Brandenburg, whose capital lies in the center, also carries a good deal of traffic, and the arrivals by water at Berlin amount to nearly 5,000,000 tons.

To the west of the monarchy, the traffic between the north and south makes use of the Rhine, the busiest waterway in Europe, on which boats carrying as much as 2,000 tons ply. The traffic interchanged at the Dutch frontier amounts to 10,000,000 tons. At Manheim, 400 kilometers (249 miles) up-stream, where the bulk of the water-borne traffic ends, the quantity is still 4,000,000 tons. But the Rhine is not connected by any other waterway with the interior of Germany or with the German ports; it is through Antwerp and Rotterdam that cereals, timber, petroleum, and minerals are imported; it is to Belgium and Holland that the Rhine helps to export quarried stone, coal from the Ruhr collieries and iron manufactured by the great Westphalian works.

In order to conserve to Germany a portion of the sea-borne traffic created by Westphalia, Prussia has already made a canal, 252 kilometers long, which has cost 100,000,000 francs (£4,000,000), between Dortmund and the Ems; this canal allows vessels drawing 2·50 meters (8 feet $3\frac{7}{8}$ inches) to pass, is 18 meters (59 feet 1 inch) in width at the bottom and 30 meters (98 feet 5 inches) across at water level, and can take vessels carrying 600 to 700 tons burden. It was opened this year (1899), so that it is too soon to say yet whether it will stimulate traffic toward the seaboard, over German territory, which the Ems could not manage. As it ends at a point where there is no important center of maritime commerce, we may question whether it is possible quickly to create de novo any great export or barge traffic.

The new canal projected, on the other hand, would connect the Rhine basin and Westphalia with the two great ports of Bremen and Hamburg, and at the same time with Berlin. It is to be made of the same dimensions as the Dortmund Canal, and the work to be done would consist of four main portions:

1. A canal carrying forward the Dortmund Canal to the Rhine, a distance of 40 kilometers (24·9 miles), with seven locks, each with two parallel docks, one 67 meters (219 feet 10 inches) and the other 95 meters (311 feet 8 inches) long; estimated cost, 57,000,000 francs (£2,280,000).

2. Additional work in rendering the canal between Dortmund and the Ems capable of carrying the extra traffic brought by the new canal, on the section, 102 kilometers (63·4 miles) long, between Herne and Bevegern, which will be used by both routes, 5,000,000 francs (£200,000).

3. The central canal between Bevegern and Heinrichsberg, on the Elbe, 325 kilometers (202 miles) long, with only five locks, and eight offshoots of a total length of 88 kilometers (54·7 miles), connecting the central canal with the chief centers in the neighborhood which it will pass and with the Weser at Minden; all this is estimated at 239,000,000 francs (£9,560,000).

4. Canalization of the Weser for 61 kilometers (37·9 miles) above Minden as far as Hameln, estimated at 25,000,000 francs (£1,000,000). The canalization down stream, from Minden to Bremen, of 149 kilometers (92·6 miles), is to be done by the State of Bremen at a cost of 54,000,000 francs (£2,160,000).

Thus the total capital expenditure for which Prussia is responsible would amount to 326,000,000 francs (£13,040,000); maintenance and working expenses were estimated at 2,700,000 francs (£108,000) per annum. From this we see that Prussia was ready to make heavy financial sacrifices for the benefit of internal navigation. But nothing can be more instructive than to examine the conditions under which it is proposed to make this sacrifice and the arguments adduced in support of the scheme.

First, it was not a queston of dividing between two competitors traffic which one could have handled unassisted. The fundamental object, constantly advanced by the supporters of the scheme, is that the railway could no longer accommodate the traffic. Nowhere, said Mr. Thielen, the Public Works Minister, not even in England, is there to be found so heavy a traffic as that of the Ruhr district, concentrated over so small an area; in a district representing $\frac{1}{112}$th of the German empire, and containing $\frac{1}{22}$nd of its population, the railways get nearly a quarter of their total traffic, and this is now increasing at the rate of 6 or 7 per cent. annually. The protests recently raised in this district because of an insufficiency of rolling stock on the State lines have not been forgotten; according to manufacturers, a good deal of business, especially for the export trade, has been lost, owing to its being impracticable to carry the traffic in proper time. Both stations and metals have reached the limit of their capacity.

The question that arises is whether, in order to carry the traffic, it is cheapest to make a canal rather than to increase the railway accommodation. Mr. Thielen maintained this view, and though some doubts were cast upon the truth of this assertion, the contrary was not authoritatively upheld; and, indeed, it could not have been so because all the railways in Prussia belong to the Government which was bringing forward the scheme. This does not mean, as is sometimes stated, that all railway men in Germany are agreed in regarding internal navigation as an auxiliary and not a rival.

Quite recently, Mr. Ulrich, president of the canal directorate, published an article which aroused widespread interest, severely criticizing the abolition of tolls, which, however, in Germany, only applied to natural waterways that have no locks. In the Zeitung des Vereins of April 8, 1899, one of the leading German economists, Prof. Gustav Cohn, expressed his astonishment at the theory that railways could not meet the demands of traffic, this being totally in contradiction with the facts observed in every instance where competition has been allowed between the two means of communication, without falsifying the results through assistance from Government funds. But once the debate in Parliament had opened, the organ of the State railways published nothing but what was in favor of the scheme. It would have been very surprising if this had not been the case. I have said that two ministers lost their portfolios, under suspicion of having been in league with the opponents of the bill; the most prominent German statesman, Mr. von Miquel, Minister for Finance, found his position in jeopardy, because though he spoke in favor of the scheme, he seemed rather lukewarm. Obviously none of the expert officials could take sides against the Minister, who himself complied with the wish of the Emperor.

We do not, therefore, know whether any careful investigations were undertaken in order to compare the expenditure that would be necessary to insure a satisfactory railway service with that required for the canal. Everything leads us to suppose either that no such estimate was made, or that the results did not suit the Government book, for we notice that during the debate the minister gave no precise figures, which he would not have failed to produce if he had been in possession of such as would have furnished convincing proofs. He mentioned the vast sums required on the whole Prussian system for additional works and new rolling stock; he alluded to the enormous expenditure on stations in great towns, expenditure in great measure incurred on the passenger service. He in no way showed that a canal, whose new sections, 403 kilometers (250·4 miles), inclusive of offshoots, are to cost 296,000,000 francs (£11,840,000) or more than 700,000 francs per kilometer (£45,061 per mile), will prove cheaper than the additional works and plant required on the existing railways, or even than a new line capable of carrying any amount of traffic, and one that would, moreover, have served several intervening districts. It is true he did speak of the exorbitant cost of land in places where factories have grown up round railways. But it seems reasonable to suppose that the simplicity of construction in the intermediate sections, where the lie of the country does not necessitate any important bridges or tunnels, would leave a fair margin as compared with the cost of the canal, which is on a par with that of the busiest railways, inclusive of the rolling stock and plant for passenger service.

One of the supporters of the scheme, realizing that the canal would be more expensive than a railway, suggested that it would be easier later on to increase its capacity, by simply doubling the very small number of locks. But it should be noted that, if only the same service is expected from a railway as from a canal, its capacity would be practically infinite, for the coexistence of passenger and ordinary services is the only cause of difficulty in working busy lines. Capacity of carrying traffic cannot, therefore, be adduced as an argument, nor can it be maintained that, when vast sums are to be spent for the sake of slow goods traffic, this can be most advantageously laid out by making a canal.

Whether the capital devoted to the canal might be better or less well spent on railway extensions, there is one point upon which no one in the Prussian Parliament seems to have any doubt, namely, that interest on the capital and maintenance expenses ought to be paid by those who use the new route. The projected canal is to levy tolls and fairly high ones, as may be seen from the accompanying table of charges suggested, according to the class of merchandise:

	First-Class.	Second-Class.	Third-Class.
From Dortmund to the Rhine	2·5 centimes (0·30d. per ton-mile).	1·875 centime (0·29d. per ton-mile).	1·25 centime (0·20d. per ton-mile).
From the Ems to the Elbe ..	1·25 centime (0·20d. per ton-mile).	0·9375 centime (0·15d. per ton-mile).	0·625 centime (0·10d. per ton-mile).

The different charges in force on the German canals and canalized rivers vary from 0·2 to 0·8 centime per ton and per kilometer (0·03d. to 0·13d. per ton and per mile). The Prussian government, though hoping that the very favorable conditions under which the traffic will be carried will enable them to charge no more than the above mentioned rates, recognized that they might see cause to alter their estimates. They also did not like to leave the treasury to assume all the burden of the speculation. The provinces concerned are to guarantee the cost of maintenance and working, together with the interest and sinking fund at 3·5 per cent. on the part of the capital, so that out of a total annual charge estimated at 14,000,000 francs (£560,000) they are to be responsible for nearly half.

As regards cost of carriage, much has been made of the advantageous conditions under which navigation will be carried on upon the central section of the canal, in the open stretches which are on the average 65 kilometers (40·4 miles) across, thus avoiding the loss of time at the locks, which, it has been stated, are the main cause of the relatively high cost of carriage on the French canals; the promoters of the scheme believe that under these circumstances the cost of carriage would fall to between 0·625 and 0·875 centime per ton-kilometer (0·10d. and 0·14d. per ton-mile), which, added to the tolls, would make an average rate per kilometer, varying according to the class of goods, of from 1·25 to 2·125 centimes (0·20d. to 0·33d. per ton-mile) on the main section, and of from 2·125 to 3·375 centimes (0·33d. to 0·53d. per ton-mile) on the section between Dortmund and the Rhine; to this must be added the terminal charges for harbor dues, loading, unloading, and transshipment, varying according to circumstances from 1 to 2 francs per ton (9·8d. to 1s. 7·5d. per English ton).

The prospectus compares these costs with those of the railway which comprise similar terminal charges and rates varying from 3 to 5·625 centimes per kilometer (0·47d. to 0·88d. per ton-mile) and falling as low as 1·875 centime (0·29d. per ton-mile) under special rates. But no attempt is made to bring out that the difference depends upon the fact that the part corresponding to the toll in the railway rates is appreciably heavier than the tolls to be levied on the canal. In order to arrive at this item, it would be necessary to find out what carriage properly speaking costs the railway, in other words, what has to be paid for the services corresponding to those of the bargemen; anything beyond this is a toll which goes toward covering cost of maintenance and management, interest on capital, and actually in Germany toward swelling the funds of the treasury in no small degree. During the debate, a speaker successfully compared the cost of carriage by water with the average cost of carriage by rail in Germany, and showed to what extent the former was below the latter. But the charges to be levied are the rates for a full barge load, for long distance traffic, exclusive of terminal charges. So far as we have seen, they have never been compared with the actual cost of traffic carried under similar conditions by full train loads over a line with hardly a single gradient. Personally we have no doubt but that such a comparison would be all in favor of the railway. A point in confirmation of this view is that in discussing the counter-effects of opening the canal upon the financial situation of the railways, the perspectus calculates that the railways will lose 84,000,000 francs (£360,000) in gross receipts, and only save 18,000,000 francs (£720,000) in expenses as a set-off. The extra expenditure now entailed upon the railways, on account of traffic which the canal will divert, added to what the railway ought to be able to keep, would, therefore, amount to but 21 per cent. of the gross receipts.

Stress was also laid during the debate upon the enormous loss the railways would incur, if they had to lower all their rates to the scale to which the canal rates for carriage would fall; but the canal would only give the public the benefit of this reduction within the very limited area that it will serve. And, though it might be found necessary to make special reductions for certain points, it is only for these that a calculation of the loss incurred by a reduction in railway rates ought to have been made, and so far as we know this estimate has not been produced.

Again, the diversion of traffic by the canal will itself also involve considerable decrease in railway receipts, for, according to the figures quoted above, the prospectus estimates the probable loss to the Prussian State railways in net earnings at 66,000,000 francs (£2,640,000), and this loss only represents four-fifths of the total loss to German and foreign railways. The hypotheses upon which this estimate is based lead to the belief that with this traffic the canal tolls would practically cover the cost of maintenance and management, the interest and sinking fund charges. There would thus, on the part of the railways, be a loss in receipts representing the interest on nearly 2,000,000,000 francs (£80,000,000), while on the part of the canal, expenses would merely be covered. Moreover, we must bear well in mind that while the works are being carried out, the railway construction capital would no doubt be laden with part of the cost of enlarging stations and adding to plant, expenses that it was intended to avoid, because it cannot be expected that the Westphalian industries will be content to remain handicapped for ten years by the present insufficiency in means of transport. It does not, therefore, seem that the expected financial results, supposing no errors in calculation to have crept in, justify the preference given to a canal over a railway, in a district that everybody agrees in regarding, nevertheless, as exceptionally favorable to navigation.

The representatives of the government laid great stress on the fact that there would be a shortcoming to make up rather than a loss to be suffered, because the profits out of the railways, which have attained 600,000,000 francs (£24,000,000) in ten years, and which continue to grow, will amply cover the deficit; the Minister for Finance declares openly that he is in no way disposed to renounce the 250,000,000 francs (£10,000,000) of profits which is obtained from working the Prussian railways after full payment of interest on capital, and which is the mainstay of his budget. He expressed his willingness to accept the expected because his colleagues assured him that it would be less than what it would cost, under the special circumstances of the case, to put the railway in a condition fit to meet requirements.

Three special circumstances failed to convince the Prussian Parliament, and the intervention of the Emperor, who let it be known on several occasions that it was his fixed intention to have the canal made, did not prevent the scheme being finally rejected, after having several times been referred back to the committee, by a majority of three, only so far as the section from Dortmund to the Rhine was concerned, and by a two-thirds majority in the case of the main canal from the Ems to the Elbe. The causes of the rejection were twofold: agrarian protectionism and the equality of treatment to which the different parts of the country have a right.

With reference to agricultural interests, the preamble set forth the facilities the canal would afford to the exclusively agricultural districts in the east of Prussia, to send their produce to the manufacturing centers in the west. But the German agrarian party refused to become infatuated with the idea of waterways, as so many French protectionists, to our personal surprise, seem to be. It is true, I am not a protectionist; and but I think it good policy not to go in for the direct opposite to protection. Now, it is certain that waterways, owing to the single fact that they form a system with far fewer ramifications than railways, are far less efficient means of transport for home agricultural produce, which must be collected from all parts of a country; on the other hand, they are eminently suitable for conveying toward inland centers imported corn which arrives in immense shiploads at seaports. The making of a canal upon which tolls are lower than on railways, and a fortiori a canal free of toll, means a premium upon imports. This is what the German agrarian party fully realized, and the real reason of the bill being rejected lay in the fear of extending the zone in which foreign wheat is seriously competing with home-grown cereals.

But it was more especially concerning the compensations demanded by other parts of the country that discussions and negotiations arose. Mr. Thielen protested extremely hotly against the actual principle of such compensations; he explained that any public work, however general its bearing, benefits more particularly certain parts of the country, and that none would ever be feasible if all local interests had to be always simultaneously consulted. In reply it was contested that, as regards railways, if one interest was served to-day, another would be to-morrow; on the contrary, even if canals were built in all parts of the country, they would never benefit more than a very limited number of localities, which would thus be favored. As soon as parliament referred the scheme back to the committee on the question of compensations, there came in innumerable claims from all sides. The only one directly

connected with the central canal was a claim on behalf of the Silesian industry and mines, who were afraid lest they should lose the Berlin market by the competition of the Ruhr coal fields; it must be acknowledged that this claim rested on a weak foundation, considering what facilities both by rail and water Silesia enjoys. But the result was a regular crop of claims for canals and railways, which had no connection with the question in hand beyond the notion that if public funds were to spent on a speculative undertaking, and if the State were in a position to make a sacrifice (by the way of giving up some of its profits from railways), everybody ought to have his share. The impossibility of complying with so many demands, without endangering the country's finances, prevented any one scheme commanding a majority.

Accordingly, the central canal scheme was brought forward and upheld solely as an exceptional measure, and one that would be less expensive, under the very peculiar circumstances, than the extension of railways that had reached the limit of their traffic capacity, and whose expenses would, moreover, be met in the shape of tolls from those who profited thereby. It was rejected on grounds of agricultural interests and of distributive justice. We gather from the debate that the scheme would have not got a soul to support it, if the question had been, like some of those at present being brought forward in France, one of duplicating a railway, already capable of carrying all the traffic, with a waterway free of toll, whose expenses would also fall upon the taxpayers, unless indeed it were decided instead to handicap the whole sea traffic of an important port whether this traffic makes use of the canal or not. It is interesting to bring to light this position of affairs, because we are so often told that Germany is a shining instance of a country where they know how to value internal navigation.

NEW CELLULOSE INDUSTRIES.

By A. D. LITTLE.

CELLULOSE has been properly called the structural basis of the vegetable world, and it is elaborated in immense amount for the purposes of the growing plant. The unit of plant structure is a cell, and the cell wall is made up of cellulose, which in the first instance is nearly or quite pure. Sometimes, as in the case of the cotton fiber, it remains nearly pure in the mature cell wall, but more commonly, as growth goes on, other substances are infiltrated upon it and become a portion of the wall, modifying by their presence the properties of the cellulose. The wood of cone-bearing trees contains, for example, only about 50 per cent. of cellulose, which is recovered nearly pure in the chemical processes for the manufacture of wood fiber.

As the plant cells according to their function may assume, or have impressed upon them, an almost infinite variety of form, it follows that cellulose, as it is supplied by nature, embodies this diversity. It is, however, always in its natural state, subject to the limitations of its availability and usefulness which are imposed upon it by the cellular or fibrous structure of the plant. In spite of these limitations, cellulose is today the chief raw material of the world. To-night I hope to describe a process by which these limitations are removed for what is, in any practical or general sense, the first time—a process which in effect makes cellulose soluble in water, and as plastic as potter's clay.

Some idea of the true position of cellulose in commerce and industry, and of its influence upon the whole social economy of the world may be obtained if you consider for a moment what the cellulose industries are. They include lumbering and the working of wood; the manufacture of wood pulp and paper; the raising, preparing, spinning, and weaving of the textile fibers, as cotton, linen, and jute; the manufacture of cordage from the so-called hard fibers, like sisal, hemp, and manila; together with the multitude of lesser industries concerned in the manufacture of celluloid, smokeless powder, pyroxylin varnishes, vulcanized fiber, parchment paper, lamp filaments, and so on. It is obvious that no raw material could have reached a position so commanding except through its possession of many desirable and useful properties.

Cellulose is a flexible, colorless, translucent, lustrous solid, about one and a half times as heavy as water, and remarkably strong and tough. In certain of its forms it has shown a tensile strength equal to that of good steel on equal sections. It is stable under the ordinary conditions of use, and very durable. It takes dyes brilliantly, may be polished easily, and in its denser forms is hard and rigid.

Cellulose itself is structureless, but by reason of its origin and the limitations of our knowledge as to how it could be worked, it commonly occurs and has been almost wholly utilized in the shape of little tubes or fibers, or of structures built up from them. In the new industries to which I am about to call your attention, we have to consider the substance itself without respect to form.

A few years ago I had the pleasure of laying before this society some of the experimental results which had then been developed from the remarkable discovery made by my friends, Messrs. Cross, Bevan, and Beadle, of London, in 1892, that when ordinary fibrous cellulose is first wet with a strong solution of caustic soda, and thereafter, while still moist, exposed to the vapor of bisulphide of carbon, a new compound, known as cellulose sulpho-carbonate is formed, which is soluble in water and extremely plastic, and which, moreover, may be readily decomposed with recovery of the original cellulose slightly modified in character and in the form impressed upon the plastic compound. The cellulose sulpho-carbonate, or cellulose xanthate as it is sometimes called, has received the commercial name of viscose.

The immense industrial importance of this discovery is rapidly becoming apparent, more especially in England and on the continent of Europe, where practically all of its commercial applications have been thus far developed. This importance rests upon the fact that the viscose process, for every practical purpose, is a process of rendering cellulose itself soluble and plastic, and thereby removing all limitation as to form. As a result, a new and rapidly expanding group of cellulose industries has arisen, and already the commercial applications of the process are going forward upon the most divergent and apparently unrelated lines. These new applications may be broadly grouped into:

Applications of the viscose solution, such as paper sizing, cloth finishing, and viscose paint;

Applications of the films and filaments of recovered cellulose;

Applications of the recovered cellulose in admixtures with other materials, as with clay, coal tar, and rubber;

The manufacture of new compounds formed or derived from the recovered cellulose, as, for example, cellulose acetate.

In all, about twenty-two different applications at present claim attention.

The use of viscose in paper making depends upon the fact that when a solution of the cellulose sulpho-carbonate is added to the mixture of stock in the paper engine, and the sulpho-carbonate then decomposed by the addition of Epsom salts, the recovered cellulose is precipitated throughout the material in the engine in the form of fine flocks which closely resemble hydrated alumina in appearance, and which are so gelatinous and adhesive as to attach themselves to the fibers, binding and cementing these together in the subsequent processes of paper making. The addition in this way of from 1 to 4 per cent. of cellulose to the paper, results in a notable increase in strength and elasticity.

The quality of the paper thus produced has led to its employment as the basis for artificial leathers for use in book binding, box making, and so on. The paper is first coated with a surface color, which is followed by a coat of a special size, after which the paper is dried and varnished. It is embossed by passing between heated rollers upon which the design has been sunk.

The advantages obtained through the use of viscose in paper sizing have led to its similar use in the manufacture of the so-called leather boards. Here again the solution is placed in the engine with the stock, and decomposed by the addition of Epsom salts, after which the stock is run off on the board machine in the usual way. The product is a board of remarkable toughness and exceptional strength.

The great viscosity of the solution of cellulose sulpho-carbonate makes it an admirable vehicle for carrying any inert material, any such additions being afterward entangled and firmly held by the recovered cellulose when the sulpho-carbonate is decomposed. One part of cellulose will in this way easily carry and hold fifteen parts of clay. These facts have been utilized in the preparation of the coated papers commonly used in the magazines and elsewhere for fine printing, and especially for half-tone work. Such papers are usually coated with mixtures of clay, zinc oxide and glue, but distinctly better results are secured when the viscose solution is substituted for the glue. The coated paper thus prepared has an especially good feel, good color, no unusual odor, and a very fine, smooth surface which takes all cuts particularly well. The particular merit of the paper is to be found in the fact that these results are secured without high glaze, and consequently with much less reflection of light from the surface than is usual in such papers.

There is a peculiar appropriateness in the application of viscose to the sizing and finishing of cotton yarn and cloth, for the reason that after the cloth or yarn has been saturated with the solution and the latter decomposed, a film of cellulose is left upon the fibers, which by joining them together gives increased strength, while by filling up their inequalities of surface, an increased luster is obtained. Thus by the addition of cellulose to the cellulose of the cloth itself, ordinary cotton cloth may be made to closely resemble linen.

Heavier coatings of cellulose, which in this case may be mixed with clay or pigments, have been applied for the production of cotton cloth and cloth for book binding. The advantages here are great by reason of the completeness with which the cloth can be filled, the hardness of the surface obtained, and the absence of all tackiness should the cloth become damp in use.

The ability of the viscose solution to carry pigments which are afterward held by the recovered cellulose has been further utilized in color printing upon cloth. Here again it is particularly advantageous that the binding material is chemically substantially the same thing as the substance of the cloth itself. The pigments are much more firmly fixed, and it becomes possible to obtain certain effects which are otherwise impossible. If the viscose solution is used alone, the printed portions of the cloth take dyes more deeply and brilliantly than the unprinted parts, so that, if the printed cloth is afterwards passed through a dye bath, the pattern stands out in darker tones upon a comparatively light ground.

From color printing to ordinary painting is a somewhat long step, but the comparatively short life of the viscose solution and its pronounced color introduced technical difficulties of some magnitude which required to be overcome before any general use could be made of viscose paint. These difficulties have recently been successfully met in Paris, where already a considerable and rapidly extending use is being made of the material in this direction. A 10 per cent. solution of viscose so prepared as to keep for several weeks, is used as the vehicle for paint, and this is now being applied upon a considerable scale to the Exposition buildings. The alkalinity of the solution, and the presence of sulphur compounds restrict somewhat the number of pigments which are available, but a sufficient number of cheap pigments are unaffected to enable one to obtain any desired shade by proper mixtures. The paint is, of course, diluted with water to the desired consistency, and is applied with a brush made of vegetable fiber instead of bristles. The paint spreads with extreme ease, and its covering power is much in excess of that of oil paint. It may be easily rubbed down, and then gives with varnish, an especially smooth, soft finish. The ratio of pigment to cellulose is as fifteen to one, and the cost price of the entire paint is about 8 centimes per kilometer. Soon after the paint has been applied, the viscose solution dries down and decomposes, so that the pigment is firmly held in place by the film of recovered cellulose.

Another important application of the viscose solution has been made in Paris, which is curiously divergent from the foregoing. Under the name of clyzol, the solution has been put upon the market there for the purpose of removing old oil paint. If this solution is applied to a painted surface of wood or iron, upon which there may be even as many as fifteen or twenty coats of old oil paint, a saponification of the oxidized oil is almost immediately effected, with the result that when the viscose dries down and decomposes, the film of recovered cellulose may be stripped away; carrying with it all the paint, and leaving the wood or metal clean. It is not even necessary to wait for the solution to dry, since, after it has been in contact with the paint for about ten minutes, a stream of water is sufficient to wash the whole away. Clyzol has been adopted by the Paris Omnibus Company among other large users, and would seem to have a wide application in the cleaning of rolling stock and large iron structures, before repainting. Many of the beautifully carved old oak doors in Paris, which at some period of bad taste had been painted, are now being cleaned with clyzol and refinished in their natural state.

The manufacture of thin films of cellulose in continuous lengths has been developed in Manchester, England, where the viscose solution is allowed to flow in a carefully regulated stream upon a heated and very smooth iron cylinder which slowly revolves the while. The solution dries down into a film upon the cylinder, from which it is then stripped off and reeled. The heat has, however, been sufficient to decompose the viscose, and the decomposition is, therefore, subsequently effected by treating the viscose film with boiling brine. The inorganic by-products diffuse out into the brine and the clear film of cellulose remains. These films are extremely tough and strong, and are destined to find a varied and wide application in the arts. They form an ideal material for use in dialyzing apparatus, and should ultimately replace parchment paper for nearly all purposes by reason of their greater thinness, better appearance and superior strength.

The preparation of thicker sheets of cellulose, having the general appearance and physical properties of sheets of celluloid, is still in the experimental stage of its development, but enough has been accomplished to prove that it is merely a question of a little time before such sheets, rivaling celluloid in beauty and variety, will be upon the market at a fraction of the cost of celluloid, and as free from danger as ordinary cardboard. These sheets, however, are much more susceptible to the action of moisture than celluloid itself, and for this reason cannot compete with celluloid in all directions.

One of the first uses to which the thin films of cellulose have been applied is in the production of artificial flowers at Breslau. I do not claim to be an expert in this particular matter, and any opinion which I may express is subject to correction by the better informed, but to my masculine eyes the flowers appear stiff and glassy. The leaves are much more satisfactory, and it is hoped that by making the films somewhat more soft in texture, much better results generally will be obtained.

One of the most ingenious of all the developments of viscose, although at present one of the least important technically, is to be noted in the process of splitting cellulose films, as discovered and worked out by Mr. Thomas, at Paris. The viscose film is first formed and allowed to gelatinize, after which it is soaked in brine to effect a further coagulation and hardening. It is then transferred to another solution, which effects almost at once a superficial decomposition of the viscose, the result being that, if a tube be inserted anywhere at the edge of the film and air blown in, the film at once splits on a plane parallel to its surfaces, and may be blown out into a bag or tube, or into irregular shapes if the original film was first cut into the proper form. It is proposed to utilize the process in the manufacture of sausage casings, packages for snuff, tobacco, etc., and also as covering for handles upon which the split film shrinks tightly, giving a finish like rawhide.

An especially important and interesting new cellulose industry involves the several processes by which the so-called artificial silk is now produced in quantity. A great deal has been said and written about this new product, in spite of which there exists nearly everywhere a complete misconception of its true character and position. Much of this misconception is due to the fact that the whole position of the industry and the whole character of the product has radically changed since May, 1898, so that conclusions based upon these earlier results are falsified to-day.

The present commercial processes for the manufacture of artificial silk depend upon the solubility of the lower nitrates of cellulose in a mixture of alcohol and ether, and upon the fact that when this solution is brought into contact with water, the nitrocellulose is precipitated. The solution is, therefore, forced into water through fine capillary apertures or spinning tubes under heavy pressure. As soon as the solution strikes the water, a filament of nitrocellulose is produced, which is drawn away from the spinning tube at the rate of about 600 meters an hour. In the process worked out by Chardonet, a simple nitrocellulose solution in the ether-alcohol mixture is employed, but owing to its viscosity it requires extremely heavy pressures to force it through the tubes. The Chardonet solution formerly contained from 7 to 8 per cent. of cellulose nitrate, but has now been brought up to about 13 per cent. An important improvement in the process was introduced by Lehner, who found that the addition of sulphuric acid to the collodion, that is, the cellulose nitrate solution, greatly lowered its viscosity and permitted the use of a 15 per cent. solution under much lower pressures than those required without this addition.

The extreme inflammability of the cellulose nitrates in themselves, and especially when in this form, would preclude their use in artificial silk were it not for the fact that, by treatment with appropriate reducing agents, the nitric acid may be removed and the filaments converted into ordinary cellulose after the manner worked out by Weston in preparation of his tamadine, in 1882. The filaments, after spinning, are therefore denitrated and, therefore, subjected to a further treatment with aluminium acetate to render them stil less readily combustible as well as less susceptible to the action of water.

In practice, a bank or battery of twelve to twenty spinning tubes or orifices is operated for each compound filament or thread produced, the single filaments being drawn together in the water, and twisted as they leave it. Practically the sole claim which the product has at present to commercial recognition is found in the surpassing luster of this artificial silk which, as the product is now made, far exceeds that of the real silk. Very many superb samples of artificial silk in the form

of floss, yarn, braid, cord, as well as dress goods and numerous other fabrics, were seen by me in London this summer, most of these having been produced by the Lehner process. All of this so-called silk has little strength and almost no wearing quality, and what little strength it has is greatly reduced when wet. It takes dyes brilliantly, however, and contrary to the general impression, is not more inflammable than cotton, as was proved by many trials. The sole field for the product is in the production of effects; for any other purpose it is merely beautiful rubbish, and its employment evidently requires special skill and knowledge in weaving. It is doubtful if more than twelve or fifteen silk spinners and weavers know, at the present time, how to handle it to obtain the best results. Despite these drawbacks, there is a sustained and insistent demand for all that can be turned out at the present time, at prices ranging from 45 to 50 francs per kilo, which is above the usual price of real silk. The present production of the several plants abroad is about 300 kilos a day, and plants to make about 650 kilos additional, are in course of erection.

A consideration of these artificial silk processes brings us back to viscose, for the reason that the viscose solution has lately been applied upon a large experimental scale at Kew, to the production of artificial silk. The solution has the obvious initial advantages of being much cheaper than the cellulose nitrate solutions, and of yielding a pure cellulose almost at once, thereby doing away with the process of denitration.

The solution is spun through fine capillary tubes into a solution of ammonium chloride, in which the viscose coagulates immediately, although without decomposition. The filaments are then drawn together into the compound thread, which is wound up on bobbins after a preliminary twisting. The viscose filaments are thereafter decomposed with recovery of the cellulose by immersing them in boiling brine.

Coming now to the applications which have been made of the recovered cellulose in admixtures with other materials, it should be made clear that when the viscose solution is allowed to decompose spontaneously, the recovered cellulose coagulates into a firm, stiff jelly, from which, as dehydration proceeds, the inorganic by-products are in large part expelled, although a prolonged soaking in water is necessary to remove them all. If, to the viscose solution, inert materials like china clay, powdered coal, graphite, untreated fiber or pigments have been added, these materials become a part of the resulting mass, and modify according to their properties, the character of the product. It is not even necessary, in making such admixtures to bring the viscose into solution, for it is itself plastic and adhesive to about the same extent as a raw rubber dough, so that, after the manner of rubber working, the viscose dough may bead mixed with various dilutents, the whole mass remaining plastic. While in this form it may be molded, stamped, squirted into rods or tubes after the manner in which lead pipe is made, or rolled out into sheets, and may even be spun upon a potter's wheel like clay. The articles thus made require to be heated over night to a temperature of about 150° F. to decompose the viscose and recover the cellulose in the form impressed upon the plastic compound. The articles are then dense and hard, but require washing in water to remove alkaline sulpho-carbonates and their by-products.

The extreme facility with which viscose can be admixed with other materials, and the general resemblance of the viscose dough to a crude rubber dough, has led to the working out of methods whereby the viscose and rubber are incorporated together so intimately that upon the subsequent decomposition of the viscose in the vulcanizing process, a film or product is obtained in which the cellulose and rubber seem to actually interpermeate each other. Thus far the application of the new mixture has been almost entirely in the manufacture of waterproof cloth for mackintoshes, although certain other products such as bicycle tires and other mechanical goods, have been turned out. In the case of mackintosh cloths, the viscose rubber mixture spreads better, and is claimed to give a less porous film than the usual mixtures. The goods can be run faster through the coating machines, and the mixture works more cleanly, but the addition of viscose certainly lowers somewhat the elasticity of the rubber.

The influence of this discovery of Cross, Bevan, and Beadle, upon the general development of the chemistry of cellulose, promises to be, perhaps, as great as it has already shown itself to be upon the purely technical development of the cellulose industries. The bearing of their discovery upon the chemistry of cellulose, apart from the general stimulus afforded by any great discovery, lies in the fact that the recovered cellulose, especially when sufficiently hydrated to correspond to the formula $C_6H_{12}O_6$, is far more reactive or susceptible to the action of chemical reagents than any of the ordinary forms of cellulose. It thus becomes possible to prepare easily and in quantities, compounds of cellulose not known before outside the laboratory, and opens up a field for new discovery. The earliest and perhaps the most important of these new commercial products is cellulose acetate, which is now prepared by the method of Cross and Weber, in quantities of several hundred pounds per day.

This method consists, briefly, in mixing the recovered cellulose with magnesium acetate, drying the mixture down, adding small quantities of acetic anhydride with a much larger proportion of acetyl-chloride, and stirring the entire mixture until the reaction starts. Carefully regulated quantities of nitrobenzol are then slowly added for the purpose of controlling the reaction and bringing the acetate into solution. The acetate is purified by precipitation in alcohol, and is then washed in water and dried.

The more immediate and obvious uses for cellulose acetate are in the preparation of varnishes and lacquers, photographic films, and sheets to replace celluloid which the acetate closely resembles in appearance and general physical character. It is, however, much less inflammable, and is especially valuable because of its high specific inductive capacity and water-repellant quality.

The greater reactivity of the cellulose recovered from viscose has also been utilized in the preparation of the cellulose nitrates, where also the granular form in which this cellulose is readily obtained offers economies in the acid treatment, and greatly facilitates subsequent washing.—Technology Quarterly.

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